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FERRY BUILDING, SAN FRANCISCO
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CALIFORNIA MINERAL PRODUCTION FOR 1925

By
WALTER W. BRADLEY

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CONTENTS.

Page

LETTER OF TRANSMITTAL ---- 7

INTRODUCTION ---- 9

CHAPTER I.

SUMMARY OF THE MINERAL INDUSTRY IN CALIFORNIA DURING THE YEAR OF 1925 ---- 11

TABULATION OF THE MINERAL PRODUCTION SHOWING COMPARATIVE AMOUNTS AND VALUES—1924 AND 1925 ---- 12

TABLE SHOWING COMPARATIVE MINERAL PRODUCTION OF THE VARIOUS COUNTIES IN CALIFORNIA FOR 1924 AND 1925 ---- 13

TOTAL PRODUCTION, 1887-1925 ---- 14

CHAPTER II.

FUELS (HYDROCARBONS)—

INTRODUCTORY ---- 15

COAL ---- 15

NATURAL GAS ---- 16

PETROLEUM ---- 20

CHAPTER III.

METALS—

INTRODUCTORY ---- 34

ALUMINUM ---- 35

ANTIMONY ---- 35

ARSENIC ---- 37

BERYLLIUM ---- 38

BISMUTH ---- 38

CADMIUM ---- 39

COBALT ---- 39

COPPER ---- 40

GOLD ---- 43

IRIDIUM. (*See* PLATINUM.)

IRON ---- 47

LEAD ---- 47

MANGANESE ---- 49

MOLYBDENUM ---- 50

NICKEL ---- 51

OSMIUM ---- 51

PALLADIUM ---- 51

PLATINUM ---- 51

QUICKSILVER ---- 53

SILVER ---- 55

TIN ---- 57

TUNGSTEN ---- 58

VANADIUM ---- 60

ZINC ---- 60

CHAPTER IV.

STRUCTURAL MATERIALS—

INTRODUCTORY ---- 62

ASPHALT ---- 63

BITUMINOUS ROCK ---- 63

BRICK AND HOLLOW TILE ---- 64

CEMENT ---- 67

CHROMITE ---- 68

GRANITE ---- 70

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CHAPTER IV—Continued.

STRUCTURAL MATERIALS—Continued. PAGE
LIME ---- 73
MAGNESITE ---- 74
MARBLE ---- 79
ONYX AND TRAVERTINE ---- 79
SANDSTONE ---- 80
SERPENTINE ---- 81
SLATE ---- 81
STONE—MISCELLANEOUS ---- 83
Paving Blocks ---- 84
Grinding Mill Pebbles ---- 84
Sand and Gravel ---- 85
Crushed Rock ---- 86

CHAPTER V.

INDUSTRIAL MATERIALS—
INTRODUCTORY ---- 90
ASBESTOS ---- 91
BARYTES ---- 93
CLAY—POTTERY ---- 94
DOLOMITE ---- 96
FELDSPAR ---- 97
FLUORSPAR ---- 98
FULLER'S EARTH ---- 99
GEMS ---- 100
GRAPHITE ---- 102
GYPSUM ---- 103
INFUSORIAL AND DIATOMACEOUS EARTHS ---- 105
LIMESTONE ---- 107
LITHIA ---- 108
MICA ---- 108
MINERAL PAINT ---- 109
MINERAL WATER ---- 110
PHOSPHATES ---- 111
PUMICE AND VOLCANIC ASH ---- 111
PYRITES ---- 112
SHALE OIL ---- 113
SILICA—SAND AND QUARTZ ---- 114
SILLIMANITE—ANDALUSITE—CYANITE GROUP ---- 115
SOAPSTONE AND TALC ---- 116
STRONTIUM ---- 118
SULPHUR ---- 118

CHAPTER VI.

SALINES—
INTRODUCTORY ---- 120
BORATES ---- 120
CALCIUM CHLORIDE ---- 122
MAGNESIUM SALTS ---- 124
NITRATES ---- 124
POTASH ---- 125
SALT ---- 126
SODA ---- 127

CHAPTER VII.

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES—
INTRODUCTORY ---- 128
ALAMEDA ---- 129
ALPINE ---- 129
AMADOR ---- 129
BUTTE ---- 130

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CHAPTER VII—Continued.

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES—Continued. PAGE
CALAVERAS ---- 130
COLUSA ---- 131
CONTRA COSTA ---- 131
DEL NORTE ---- 131
EL DORADO ---- 132
FRESNO ---- 132
GLENN ---- 133
HUMBOLDT ---- 133
IMPERIAL ---- 134
INYO ---- 134
KERN ---- 135
KINGS ---- 135
LAKE ---- 136
LASSEN ---- 136
LOS ANGELES ---- 136
MADERA ---- 137
MARIN ---- 137
MARIPOSA ---- 138
MENDOCINO ---- 138
MERCED ---- 138
MODOC ---- 139
MONO ---- 139
MONTEREY ---- 139
NAPA ---- 140
NEVADA ---- 140
ORANGE ---- 141
PLACER ---- 141
PLUMAS ---- 142
RIVERSIDE ---- 142
SACRAMENTO ---- 143
SAN BENITO ---- 143
SAN BERNARDINO ---- 144
SAN DIEGO ---- 144
SAN FRANCISCO ---- 145
SAN JOAQUIN ---- 145
SAN LUIS OBISPO ---- 146
SAN MATEO ---- 146
SANTA BARBARA ---- 146
SANTA CLARA ---- 147
SANTA CRUZ ---- 147
SHASTA ---- 148
SIERRA ---- 148
SISKIYOU ---- 149
SOLANO ---- 149
SONOMA ---- 149
STANISLAUS ---- 150
SUTTER ---- 150
TEHAMA ---- 151
TRINITY ---- 151
TULARE ---- 151
TUOLUMNE ---- 152
VENTURA ---- 152
YOLO ---- 153
YUBA ---- 153

APPENDIX.

MINING BUREAU ACT ---- 154
PUBLICATIONS OF THE STATE MINING BUREAU ---- 157
INDEX ---- 167

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ILLUSTRATIONS.

PAGE

Lorenz Hydraulic Mine, near Weaverville, Trinity County ... 43

P. & H. Gasoline Steam-Shovel and Pierce Gravel Gold-Washing Machine on Jenkins & Taylor Placer near French Gulch, Shasta County ... 45

Concentrating Plant of California Zinc Company at Winthrop, Shasta County ... 61

Plant of Santa Cruz Portland Cement Company, Davenport, Santa Cruz County. Airplane photo ... 66

El Dorado County Slate Placed on Roof of a Residence Being Built in Oakland, California ... 82

Plant of Granite Rock Company at Logan, San Benito County ... 85

Asbestos Fiberizing Mill of the San Benito Asbestos Company, San Benito County 91

Gypsum Deposit of Pacific Portland Cement Company in the Fish Mountains, Imperial County ... 104

Three-Hundred-Ton Plaster Mill of Pacific Portland Cement Company at Plaster City, Imperial County ... 104

MAPS AND CHARTS.

Graph Showing Annual Value and Increase of Mineral Production of California from 1890 to 1924 ... 14

Monthly Production and Utilization of Natural Gas in Southern California ... 18

Monthly Production of Casing-Head Gas in the California Oil Fields ... 18

Outline Map of California Showing Location of Oil Fields and Districts ... 27

Current Trend of World Production of Major Non-Ferrous Metals ... 36

Prices of Electrolytic Copper, Wire Bars, Ingot Bars and Cakes F. O. B. Eastern Seaboard Refinery, Cents per Pound ... 40

Prices of Common Lead, Desilverized and Soft Missouri, at New York City, Cents per Pound ... 48

Prices of Bar Silver Bullion, 999 Fine at New York City, Cents per Troy Ounces 56

Prices of Slab Zinc, Prime Western Brands, at St. Louis, Missouri, Cents per Pound ... 60

Prices of Canadian Asbestos "Crude" and "Fiber," F. O. B. Quebec, 1922-1925 ... 92

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LETTER OF TRANSMITTAL.

September, 1926.

To His Excellency, THE HONORABLE FRIEND WM. RICHARDSON,
Governor of the State of California.

SIR: I have the honor to herewith transmit Bulletin No. 97 of the State Mining Bureau, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

LLOYD L. ROOT,
State Mineralogist.

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INTRODUCTION.

It is the endeavor of the staff of the State Mining Bureau, in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the cooperation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January will result in earlier completion of the manuscript. Statistics lose much of their value if their publication is unnecessarily delayed.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

LLOYD L. ROOT,
State Mineralogist.

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MINERAL INDUSTRY, CALIFORNIA, 1925.

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE MINING BUREAU, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA.

CHAPTER ONE.

The total value of the mineral output of California for the year 1925 was $434,519,660, being an increase of $59,898,871 over the 1924 total of $374,620,789. There were fifty-five different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1925 compared with the preceding year were: The considerable increase in value of the petroleum yield. Material advances were also made by cement, miscellaneous stone, zinc, lead, and quicksilver; while decreases were registered by brick and hollow building blocks and by salt. Gold, copper, silver, and pottery clay fairly well held their own with only slight drops in total value. There were a number of other minor variations. The net result was an increase in the grand total for all groups of practically sixty million dollars, as stated above. Petroleum accounted for an increase of $55,956,955 in total value, due both to advanced prices and an increase from 228,933,471 barrels to 232,492,147 barrels in quantity, or a difference of 3,558,676 barrels.

Of the metals: lead increased from 4,984,387 pounds, worth $398,751, to 7,352,422 pounds, worth $639,661; zinc from 3,060,000 pounds and $198,000 to 11,546,602 pounds and $877,542; quicksilver from 7,948 flasks and $543,080 to 7,683 flasks and $621,831; platinum from 273 fine ounces and $36,452 to 292 fine ounces and $39,937. Though gold decreased slightly, California continues to account for approximately 30 per cent of the gold output of the United States.

Of the structural group: cement advanced from 11,655,131 barrels, worth $23,225,850, to 13,206,630 barrels, worth $25,043,335; granite from a valuation of $1,211,046 to $1,853,859. Brick and hollow building blocks or tile decreased in total value from $9,137,908 to $7,503,976, due mainly to common brick, though all classes showed drops except fire-brick which advanced slightly in value for a slightly smaller quantity. Lime and magnesite both dropped off slightly. Of the 'industrial' group, as is usually the case, there were a number of fluctuations, mineral water and the sillimanite group being the only ones to show material increases. Of the salines, calcium chloride, potash, and soda increased in value, with the borates, magnesium salts, and common salt decreasing.

The figures of the State Mining Bureau are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any state in the United States, and probably more than any other equal area elsewhere of the earth. The total

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annual value of her output has been surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. The past two years, California has been second only to Pennsylvania. California was for many years the sole domestic source of borax, chromite and magnesite and in which we still lead. We lead all other states in the production of gold, quicksilver, and platinum; and have alternated in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

By Substances.

The following table shows the comparative yield of mineral substances of California for 1924 and 1925, as compiled from the returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	70 tons	$4,750	*	*	* —
Bituminous rock	6,040 tons	14,922	*	*	* —
Borates	52,070 tons	1,599,149	46,124 tons	$1,526,938	$72,211—
Brick and hollow building tile		9,137,908		7,503,976	1,633,932—
Cement	11,655,131 bbls.	23,225,850	13,206,630 bbls.	25,043,335	1,817,485+
Chromite	350 tons	6,700	591 tons	10,912	4,212+
Clay (pottery)	417,928 tons	651,857	537,587 tons	674,376	22,519+
Coal	1,425 tons	8,800	730 tons	3,880	4,920—
Copper	52,089,349 lbs.	6,823,704	46,968,499 lbs.	6,669,527	154,177—
Dolomite	28,843 tons	71,271	42,852 tons	104,900	33,629+
Feldspar	9,055 tons	68,112	8,165 tons	59,615	8,497—
Fuller's earth	5,290 tons	67,295	5,280 tons	91,842	24,547+
Gems		4,800		10,663	5,863+
Gold		13,150,175		13,065,330	84,845—
Granite		1,211,046		1,853,859	642,813+
Gypsum	25,569 tons	53,210	107,613 tons	172,444	119,234+
Lead	4,984,387 lbs.	398,751	7,352,422 lbs.	639,661	240,910+
Lime	62,024 tons	703,355	61,922 tons	685,528	17,827—
Limestone	219,476 tons	582,660	319,977 tons	494,525	88,135—
Lithia	109 tons	2,269			2,269—
Magnesite	67,236 tons	900,183	64,623 tons	872,944	27,239—
Magnesium salts	4,823 tons	145,883	4,221 tons	132,553	13,330—
Manganese ore	1,115 tons	25,785	832 tons	19,450	6,335—
Marble	[a]61,579 cu. ft.	140,253	35,661 cu. ft.	116,105	24,148—
Mineral paint	532 tons	5,234	669 tons	6,969	1,735+
Mineral water	8,159,211 gals.	818,726	12,115,072 gals.	1,230,455	411,729+
Natural gas	209,921,566 M cu. ft.	15,153,140	194,719,924 M cu. ft.	15,890,082	736,942+
Onyx and travertine	[b]		19,940 cu. ft.	16,120	16,120+
Petroleum	228,933,471 bbls.	274,652,874	232,492,147 bbls.	330,609,829	55,956,955+
Platinum	273 fine oz.	36,452	292 fine oz.	39,937	3,485+
Potash	33,107 tons	747,407	36,355 tons	829,770	82,363+
Pumice and volcanic ash	4,919 tons	33,404	5,319 tons	32,937	467—
Pyrites	124,214 tons	517,835	129,500 tons	528,550	10,715+
Quicksilver	7,948 flasks	543,080	7,683 flasks	621,831	78,751+
Salt	318,800 tons	1,159,137	284,068 tons	949,826	209,311—
Sandstone	6,700 cu. ft.	3,600	14,704 cu. ft.	14,362	10,762+
Silica (sand and quartz)	6,808 tons	35,006	12,498 tons	96,780	61,774+
Silver	3,555,153 fine oz.	2,381,952	3,054,416 fine oz.	2,119,765	262,187—
Soapstone and talc	16,179 tons	242,770	15,465 tons	239,084	3,686—
Soda	32,536 tons	711,796	48,625 tons	947,649	235,853+
Stone, miscellaneous [c]		15,966,380		17,409,854	1,443,474+
Tungsten concentrates	781 tons	446,009	573 tons	348,471	97,538—
Zinc	3,060,000 lbs.	198,900	11,546,602 lbs.	877,542	678,642+
Unapportioned		[d]1,968,399		*1,957,484	10,915—
Total values		$374,629,789		$434,519,660	
Net increase					$59,898,871+

*Under 'unapportioned.'

[a] Includes onyx and travertine.

[b] Combined with marble.

[c] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel, and grinding-mill pebbles.

[d] Includes calcium chloride, diatomaceous earth, iron ore, shale oil, sillimanite-andalusite, sulphur, aluminum sulphate, glauber salt, potash alum, mica schist, radio galena crystals, arsenic.

[e] Includes calcium chloride, bituminous rock, antimony, asbestos, graphite, infusorial and diatomaceous earth, iron ore, shale oil sillimanite-andalusite.

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By Counties.

The following table shows the comparative value of the mineral production of the various counties in the state, for the years 1924 and 1925:

County.	*1924*	*1925*
Alameda	$2,634,645	$2,916,506
Alpine	2,552	520
Amador	2,938,865	2,625,703
Butte	641,750	546,178
Calaveras	1,572,419	1,450,618
Colusa	77,267	103,230
Contra Costa	2,348,090	2,544,179
Del Norte	722,265	270,582
El Dorado	395,572	352,828
Fresno	12,547,798	9,264,996
Glenn	41,550	92,288
Humboldt	485,478	719,151
Imperial	139,968	330,965
Inyo	2,110,075	2,585,145
Kern	74,164,151	89,400,726
Kings	725	520
Lake	96,396	73,348
Lassen	37,908	2,404
Los Angeles	168,420,799	193,180,000
Madera	955,469	1,377,458
Marin	527,231	434,802
Mariposa	234,707	634,862
Mendocino	60,768	16,533
Merced	87,603	80,262
Modoc	1,500	2,400
Mono	126,691	184,745
Monterey	286,490	277,721
Napa	359,265	229,172
Nevada	2,945,267	2,352,877
Orange	40,481,210	49,104,490
Placer	492,180	550,413
Plumas	3,876,105	4,401,508
Riverside	5,508,244	5,179,108
Sacramento	2,196,210	2,504,405
San Benito	2,144,603	2,617,396
San Bernardino	12,642,431	14,179,663
San Diego	1,013,119	1,129,757
San Francisco	150,258	131,158
San Joaquin	602,500	737,818
San Luis Obispo	317,779	136,477
San Mateo	302,171	1,577,513
Santa Barbara	5,159,740	4,338,431
Santa Clara	1,150,401	1,320,858
Santa Cruz	4,339,233	3,227,036
Shasta	4,754,664	4,300,449
Sierra	812,476	1,386,301
Siskiyou	140,787	219,626
Solano	3,089,475	2,678,547
Sonoma	172,051	160,231
Stanislaus	345,138	415,466
Sutter	97	397
Tehama	34,454	77,183
Trinity	509,344	502,289
Tulare	498,674	426,979
Tuolumne	629,156	567,248
Ventura	6,089,394	17,853,540
Yolo	15,800	23,060
Yuba	2,189,881	2,721,594
Total values	$374,620,789	$434,519,660

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Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined; though structural materials and copper increased in 1920–1924, also lead and magnesite in 1923; lead and zinc in 1925.

Total Mineral Production of California, by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,986,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,750,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,137,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,679	19,715,440	37,683,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,301,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,182,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
1925	434,519,660	13,065,330	330,609,829
Total values	$3,904,915,476	$641,813,072	$2,213,747,928

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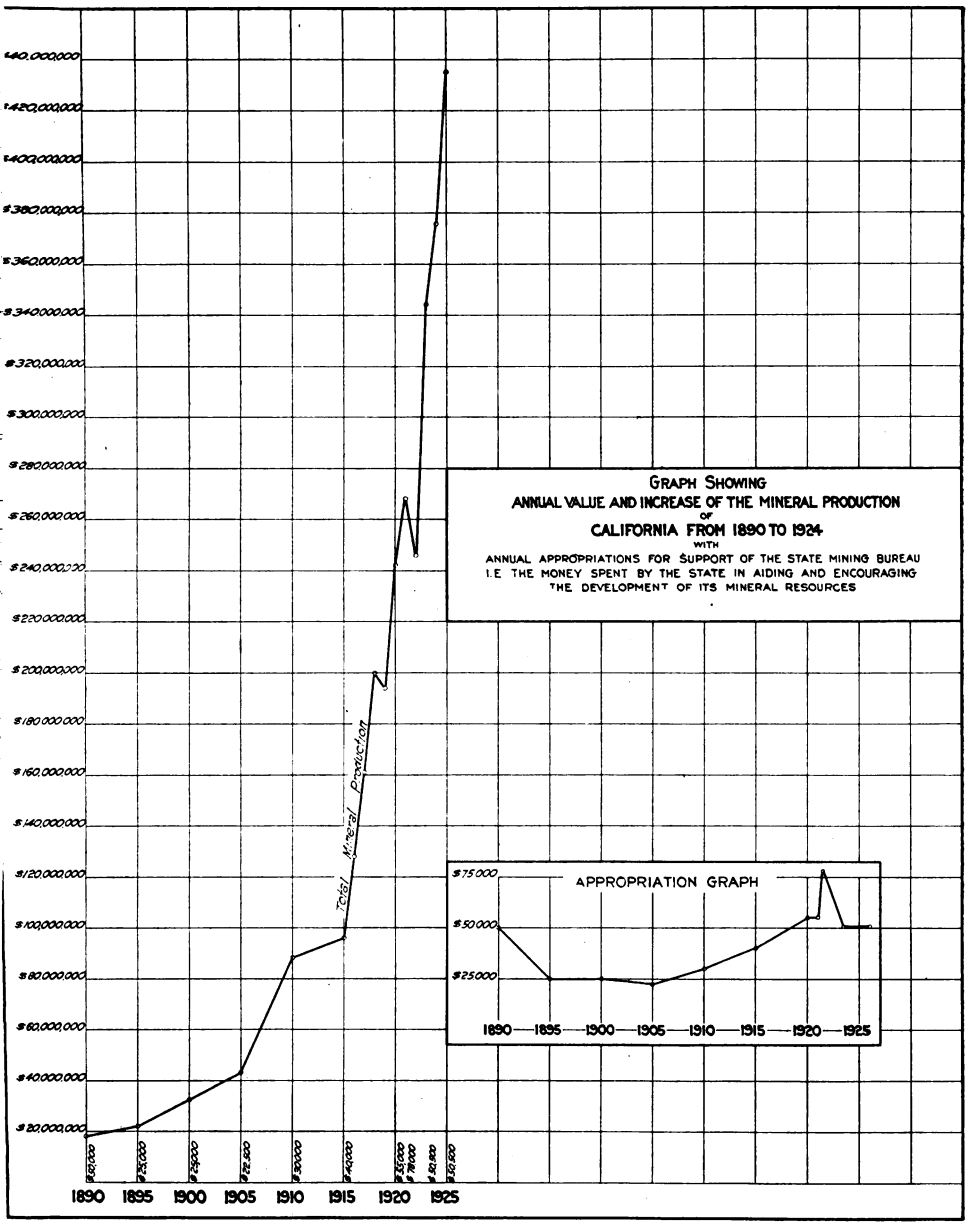

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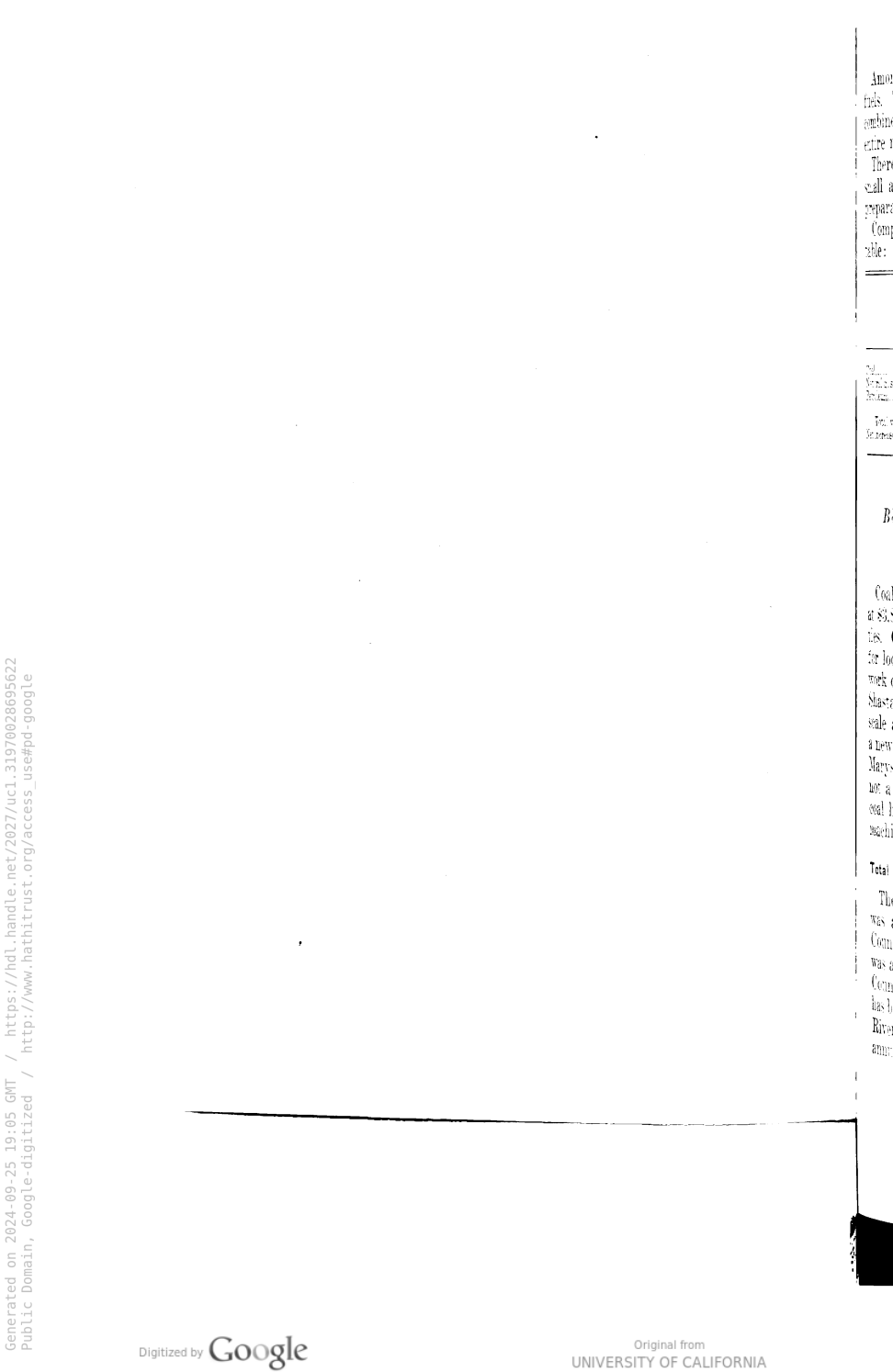

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CHAPTER TWO.

FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up practically 80 per cent of the state's entire mineral output for the year 1925.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Comparison of values during 1924 and 1925 is shown in the following table:

	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Coal	1,425 tons	$8,800	730 tons	$3,880	$4,920—
Natural gas	209,921,596 M cu. ft.	15,153,140	194,719,924 M cu. ft.	15,890,082	736,942+
Petroleum	228,933,471 bbls.	274,652,874	232,492,147 bbls.	330,609,829	55,956,955+
Total value		$289,814,814		$346,503,791	
Net increase					$56,688,977+

COAL.

Bibliography: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXI (inc.). U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; Ann. Rpt. 22, Pt. III.

Coal production in California in 1925 totaled 730 short tons valued at $3,880, being credited to Amador, Mendocino, and Riverside counties. Only a small part of it was marketed, as it was mainly consumed for local camp purposes and for power and forge use in development work on the deposits. Considerable development work is under way in Shasta County, as well as in Mendocino. Experiments on a commercial scale are being made by the Pacific Gas and Electric Company with a new type of generator to produce gas from Californian coal at their Marysville gas plant. Incidentally the new method of gas making is not a return to that in use before the introduction of oil, when the coal had to be retorted 12 to 14 hours. It is stated that in the new machines coal will be transferred into gas in five minutes.

Total Coal Production of California.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. Stone Canyon, Monterey County, was also an important producer for a short time, and there has been some coal shipped from properties in Amador, Fresno, Orange, Riverside and Siskiyou counties. The following tabulation gives the annual tonnages and values, according to available records:

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Coal Output and Value by Years.

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1895	79,858	$193,790
1862	23,400	134,550	1896	70,649	161,335
1863	43,200	248,400	1897	87,449	196,255
1864	50,700	291,525	1898	143,045	337,475
1865	60,530	348,048	1899	160,941	420,109
1866	84,020	483,115	1900	176,956	535,531
1867	124,690	716,968	1901	150,724	401,772
1868	143,676	826,137	1902	88,460	248,622
1869	157,234	904,096	1903	93,026	265,383
1870	141,890	815,868	1904	79,062	376,494
1871	152,493	876,835	1905	46,500	144,500
1872	190,859	1,097,439	1906	24,850	61,600
1873	186,611	1,073,013	1907	23,734	55,849
1874	215,352	1,238,274	1908	18,496	55,503
1875	166,638	958,169	1909	40,389	216,913
1876	128,049	736,282	1910	11,033	23,484
1877	107,789	619,787	1911	11,047	18,297
1878	134,237	771,863	1912	14,484	39,092
1879	147,879	850,304	1913	25,198	85,809
1880	236,950	1,362,463	1914	11,859	28,806
1881	140,000	805,000	1915	10,299	26,662
1882	112,592	647,404	1916	4,037	7,030
1883	76,162	380,810	1917	3,527	7,691
1884	77,485	309,950	1918	6,343	16,149
1885	71,615	286,460	1919	2,983	8,203
1886	100,000	300,000	1920	2,078	5,450
1887	50,000	150,000	1921	12,467	63,578
1888	95,000	380,000	1922	27,020	135,100
1889	121,280	288,232	1923	1,010	5,090
1890	110,711	283,019	1924	1,425	8,800
1891	93,301	204,902	1925	730	3,880
1892	85,178	209,711			
1893	72,603	167,555	Totals	5,207,310	$23,098,358
1894	59,887	139,862			

The tonnages in the above table for the years 1861–1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93–94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary, Oil & Gas Supervisor, Dec. 1919; Aug., 1922; Mar., 1923; Mar. and Apr., 1926.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necesssary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accom-

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panying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam driven plants.

The most notable gas developments in California in recent years have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district, and in the new oil fields in the Los Angeles basin, Los Angeles and Orange counties.

The following paragraphs are quoted, with accompanying charts, from a recent report by Mr. C. C. Brown,[1] gas engineer of the Railroad Commission of California, which is a continuation of the earlier report by Masser.[2]

"The oil industry is coming to realize more and more the important role which natural gas plays in the economic recovery of petroleum from the oil fields. In the past little attempt has been made to conserve the gas within the oil reservoirs, it being felt that the production or rather, the releasing, of the initial compressed gas was an unavoidable factor in oil field operation, and that the wastage of this product over and above the amount needed for field use and sale under existing contracts to gas distributing companies was not a serious economic loss.

"However, recent experiments and tests have definitely proved that the conservation of this natural gas within the oil sands is of utmost importance to the oil operator if he is to secure the maximum length of producing life and maximum total production of oil from his wells.

"As a matter of fact, gas is being reintroduced into the oil-bearing strata in a number of cases where the original gas had been dissipated and where the wells had long ceased to flow. The results achieved by this procedure have been, to some extent, encouraging.

"Another factor that has tended to emphasize the value of natural gas in the last few years is the installation of large numbers of gasoline extraction plants, through which tremendous quantities of casing-head gas are being processed for the extraction of natural gasoline.

"The natural gasoline industry has grown from a comparatively few small plants installed some twenty years ago to something over eleven hundred plants in the United States, with a capitalization of over $250,000,000, with a total daily capacity of about four and one-half million gallons. The production of natural gasoline is increasing at the rate of approximately 10 per cent a year.

* * * * * * * *

"Another very tangible factor in the value of natural gas is its value as a fuel commodity. * * * In the greater portion of this territory, natural gas is utilized for domestic, commercial and industrial purposes. In the cities of Los Angeles and Santa Barbara a mixed gas is used having a heat value of 850 B.t.u. per cubic foot. This gas is produced by 'cracking' or 'reforming' natural gas and mixing it with straight natural gas having a heat value of about 1200 B.t.u.

"The 'reforming' or 'cracking' of natural gas is a process of much interest to several of the southern California gas utilities. During the major portion of the year there exists an abundance of natural gas, more than sufficient to provide for mixing requirements. In this period, the artificial gas portion of the commercial mixture may be manufactured by 'reforming' natural gas rather than by producing this gas from oil, which is vastly more efficient thermally than is the oil gas process. In addition to the economy on a heat unit basis, there is a further saving due to the somewhat lower price of natural gas as compared with oil upon an equivalent fuel value. In view of these efficiencies and economies, it has been the regular practice of the two utilities in Los Angeles since about 1917 to manufacture as much as possible of the required volume of artificial gas by reforming. This economy is, of course, recognized by the Railroad Commission, and present gas rates reflect the benefit to the consumer.

"The reforming process is carried on in the regular type of straight shot oil gas generator, without any important change whatsoever in construction. The operation of the generator is practically the same as for oil gas production, and it is therefore possible to change from oil to natural gas at any time, according to the local requirements of the natural gas supply.

"In this process the methane and ethane are partially decomposed into carbon and hydrogen, with an accompanying increase of volume and reduction in heat value per cubic foot. The extent of the decomposition of the natural gas varies with the generator temperature and the time of contact of the gas with the hot brickwork. Therefore, with constant temperatures within the normal operating range of the generator, the quality of the reformed gas made varies with the rate of introduction of natural gas into the machine; further, the capacity of the machine increases with the higher B.t.u. quality, as the natural gas is injected at a higher rate per hour to obtain a shorter period of contact with hot brickwork, and a correspondingly lesser decomposition.

"The primary decomposition of the natural gas on contact with the hot brickwork is the breaking down the ethane (C_2H_6) which is less stable chemically than methane. This is indicated by analysis of reformed gases which are entirely lacking

[1] Brown, C. C., Natural gas in California: Rep. of State Oil and Gas Sup., California State Mining Bureau, Vol. 11, No. 9, pp. 8-28, Mar. 1926.

[2] Masser, H. L., Rep. of State Oil and Gas Sup., Vol. 8 No. 9, Mar. 1923. See also Cal. State Min. Bur. Bulletin 93.

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in ethane, while methane is still present in large percentages. While ethane is the less stable of the two hydrocarbons, it requires a greater amount of heat to completely decompose it. However, the decomposition doubtless proceeds in two stages, first forming methane, which is then subject to decomposition in the same manner as the other methane originally present in the gas.

"At such times as there is not sufficient available natural gas for reforming purposes, the process of oil gas manufacture is resorted to. The oil or gas is then enriched with natural gas to bring the mixture up to the required 850 B.t.u. quality."

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1925 gave from 3¢ to 25¢ per 1000 cu. ft., at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1925 works out at approximately 8.2¢. Approximately 7000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine, and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1925.

County.	*M cu. ft.*	*Value.*
Fresno	1,515,889	$116,711
Kern	45,649,845	2,290,608
Kings	740	440
Los Angeles	98,226,700	8,704,894
Orange	26,324,369	2,324,014
Santa Barbara	2,545,208	248,708
Tulare	280	175
Ventura	20,144,646	1,953,163
Butte, Humboldt, Lake, Mendocino, Sacramento, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Sutter, Yuba*	312,247	251,369
Totals	194,719,924	$15,890,082

* Combined to conceal output of a single operator in each.

The above totals for 1925 compare with 209,921,596 M cu. ft., valued at $15,153,140 in 1924. The only important increase in quantity in 1925 was made by Ventura County, which shows 20,144,646 M cu. ft., worth $1,953,163 as against 5,995,760 M cu. ft. and $633,352 in 1924. This was due to exploitation of deeper oil sands in the Ventura field. Fresno County showed a slight increase, Los Angeles, Orange, and Kern counties, in the order named, utilized somewhat smaller quantities of natural gas; but, with the exception of Los Angeles, there was a larger recovery of natural-gas gasoline from the gas treated.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in California was from the famous Court House well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic

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PLATE I.

CALIFORNIA OIL FIELDS
TOTAL MONTHLY PRODUCTION CASING-HEAD GAS, Mcf.

Accompanying Report by C.C. Brown

CALIFORNIA STATE MINING BUREAU
R.D. BUSH
STATE OIL & GAS SUPERVISOR

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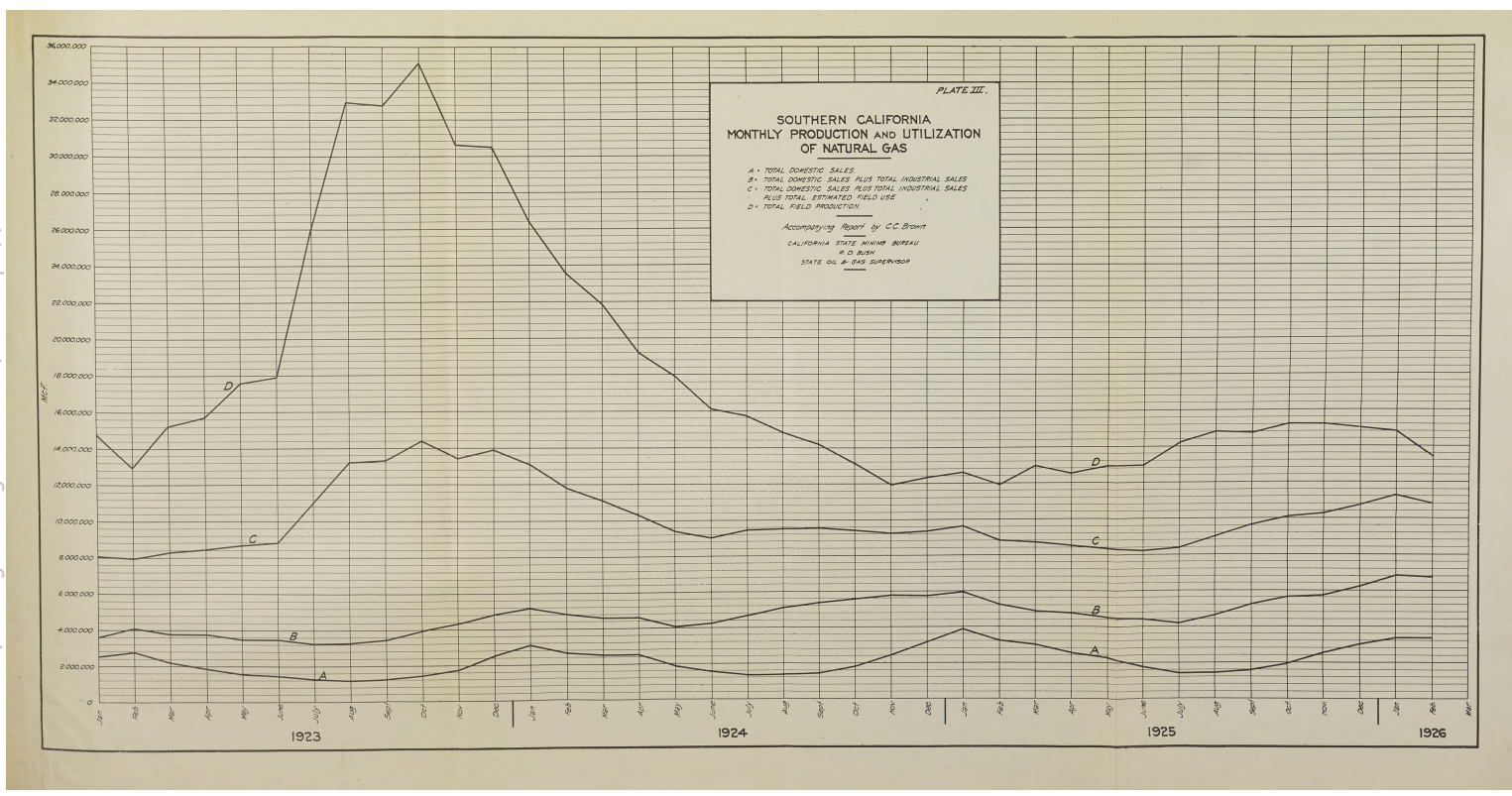

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records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Year	M cubic feet	Value	Year	M cubic feet	Value
888	[a]12,000	$10,000	1908	842,883	$474,584
889	[a]14,500	12,680	1909	1,148,467	616,932
890	[a]41,250	33,000	1910	10,579,933	1,676,367
891	[a]39,000	30,000	1911	[a]5,000,000	491,859
892	[a]75,000	55,000	1912	[a]12,600,000	940,076
893	[a]84,000	68,500	1913	14,210,836	1,053,292
894	[a b]85,080	79,072	1914	16,529,963	1,049,470
895	[a b]110,800	112,000	1915	21,992,892	1,706,480
896	[a b]131,100	111,457	1916	28,134,365	2,871,751
897	[a]71,300	62,657	1917	44,343,020	2,964,922
898	[a]111,165	74,424	1918	46,373,052	3,289,524
899	115,110	95,000	1919	52,173,503	4,041,217
[illegible]	40,566	34,578	1920	58,567,772	3,898,286
[illegible]	120,800	92,034	1921	67,043,797	4,704,678
[illegible]	120,968	99,443	1922	103,628,027	6,990,030
903	120,134	75,237	1923	240,405,397	15,661,433
904	144,437	91,035	1924	209,021,596	15,890,082
905	148,345	102,479	1925	194,719,924	15,890,082
906	168,175	109,489			
907	169,991	114,759	Totals	1,130,139,148	$84,936,967

[a] Quantity, in part, estimated, where values only were reported.
[b] Includes natural CO_2 from a mine in Santa Clara County.

Gasoline from Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 163 plants operated by 83 operating companies or individuals were in operation in 1925 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the oil fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the long pipe lines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipe lines thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained. A total of 301,755,000 gallons of casing-head gasoline valued at $39,288,500 from all fields was reported as made during 1925, compared with 169,781,000 gallons valued at $22,269,955 by 82 operators and 137 plants in 1924. It was distributed by counties, as follows:

Natural-Gas Gasoline Recovered, 1925.

County	No. plants	Gallons	Value
[illegible]	1	587,000	$76,427
[illegible]	44	59,030,000	7,685,706
Angeles	76	177,920,000	23,165,184
[illegible]ge	29	45,040,000	5,864,208
[illegible] Barbara	4	6,891,000	897,208
[illegible]ra	9	12,287,000	1,599,767
Totals	163	301,755,000	$39,288,500

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The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. A recent report by Mashaw & Swanson[1] gives the average recovery for 1925 as 1.281 gallons per 1000 cu. ft. of gas treated. Their figures show the following production, by methods:

Natural-Gas Gasoline Production, 1925, by Methods.

(Per U. S. Bureau of Mines)

Method.	*Gallons*	*Recovery (Gal. per M cu. ft.)*
Oil absorption	176,659,197	1.117
Compressor	6,718,091	1.369
Combination compressor and oil absorption	86,156,130	1.436
Combination oil and charcoal absorption	33,367,546	1.539
Drip	279,113	----
Totals	303,180,077	1.281

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919). U. S. Geol. Surv., Bulletins 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691; Prof. Papers, 116, 117. "American Petroleum; Supply and Demand"; Amer. Petr. Inst., 1925.

The crude oil production of California for 1925 amounted to a total of 232,492,147 barrels of clean oil, valued at $330,609,829 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the old Los Angeles City field not under the jurisdiction of the Supervisor, and a small production in San Mateo County which was also not reported to that office.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales. This is particularly true on a rising or a falling market.

A comparison of the sales and quotations averages for the past ten years reveals a number of interesting developments, among which may be noted the following: On a rising market the average sales price for the year will be lower than the average of quotations; and on a falling market the average of sales will be higher than the quotation average. This is probably due, in part at least, to sales under time contracts.

[1] Mashaw, J. W., and Swanson, E. B., Statistical summary of the California petroleum industry, 1925: U. S. Bureau of Mines, 1926, p. 27.

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Features of 1925.

The noteworthy features of the year 1925 in the oil industry of California were the higher prices prevailing and the increase in production due to the newer fields of Inglewood, Rosecrans, Dominguez, and Ventura, though this increase was partly offset by the increased amount of closed-in production and partly by decline in some of the older fields, particularly Long Beach.

Summarizing the data for the year, the State Oil and Gas Supervisor[1] presented the following figures:

"The total production of the state for the last six months of 1925 was 120,623,010 barrels of oil and 53,519,125 barrels of water. The production of oil for the year 1925 was, therefore, 232,334,238 barrels, an increase of 3,625,767 barrels over 1924. Production increased, notwithstanding that the amount of closed-in production in the state increased during the latter half of the year. The increased production was principally from four fields as follows:

Field.	*Increase of 1925 over 1924 production*
Inglewood	18,365,356 barrels
Rosecrans	7,191,880 barrels
Dominguez	6,767,640 barrels
Ventura	5,182,597 barrels
Total	37,507,473 barrels

This increase was partly offset by the increased amount of closed-in production, and partly by decline in some of the older fields, notably Long Beach, which produced 19,527,931 barrels less in 1925.

"The production of oil for the last half of 1925 was 8,911,782 barrels more than for the first half. Water production decreased 1,760,012 barrels during the same periods.

"The estimated closed-in production remained constant at about 25,000 barrels daily during the first five months of the year, but in June additional production from Elk Hills and Midway-Sunset was closed in, and the amount increased steadily in those and other fields to 60,454 barrels daily in December.

* * * * * * *

"Storage and Price Changes.

"The total crude and refined petroleum in storage in Pacific coast territory at the end of 1925 was 153,796,682 barrels, according to the American Petroleum Institute. The increase in storage during the year amounted to 28,774,718 barrels compared with an increase in 1924 of 8,294,522 barrels. The total amount of crude and refined oil shipped to eastern ports during 1925 was 27,937,000 barrels or 19,690,000 barrels less than the 1924 shipments.

"Prices of crude averaged higher in 1925 than in 1924. The prevailing price range of $1 to $1.82 per barrel in January was increased in February to a range of $1.25 to $2.40 per barrel and continued at that level until September 21, when it was reduced, ranging from $0.90 to $2.30 per barrel. A further reduction was made October 27 when the range in price was $0.75 to $2.30, affecting only the heavier grades. These prices continued for the remainder of the year.

"Drilling and Development.

"During 1925, 1359 wells were reported to the State Oil and Gas Supervisor as ready to drill, as compared with 1352 new wells in 1924. Of the total number 107, or 8 per cent, were wildcat wells. No new fields of importance were discovered, but considerable new producing area was added by extensions of the Long Beach and Midway fields. A small amount of oil was discovered at Seal Beach, Los Angeles County; in Sonoma County, near Petaluma; and in Monterey County, southwest of Salinas. New and deeper producing horizons were discovered in the Brea-Olinda, Sunset, and Cat Canyon fields."

Outlook for 1926.

Figures for the first six months of 1926 indicate a slight decline in yield for the current year compared with 1925. Production has dropped to around 610,000 barrels per day from the 1925 average of 634,000 barrels daily. Effective March 11th, prices were advanced for the lighter grades of crude oil.

[1] Bush, R. D., Résumé of oil field operations in California in 1925: Cal. State Min. Bur., 11th Ann. Rep. of State O. and G. Super. No. 8, Feb. 1926, pp. 5 and 6.

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Production Figures.

The following table gives the production and value by counties for 1925, compared with the 1924 figures:

TABLE A.

Production and Value of Crude Oil, by Counties.

	1924		1925	
County.	*Barrels.*	*Value.*	*Barrels.*	*Value.*
Fresno	10,156,405	$11,801,743	7,773,665	$8,503,390
Kern	61,175,405	69,572,934	58,852,742	84,255,094
Los Angeles	119,027,428	147,474,953	121,214,551	173,215,593
Orange	31,661,283	37,455,298	32,734,420	46,384,673
San Luis Obispo	31,222	30,972	29,590	32,164
Santa Barbara	2,905,181	3,009,768	2,647,380	2,419,705
Santa Clara	14,417	20,481	13,828	22,594
Ventura	3,958,010	5,279,985	9,221,846	15,769,357
San Bernardino and San Mateo	[a]4,120	6,740	[b]4,125	7,259
Totals	228,933,471	$274,652,874	232,492,147	$330,609,829

[a] Combined to conceal output of a single operator in each.
[b] Combined to conceal output of a single operator in San Bernardino County.

The foregoing totals show a state average price of $1.422 per barrel for the year 1925, as compared to $1.200 in 1924 and $0.923 in 1923.

TABLE B.

Average Price of Oil per Barrel, by Counties, 1916-1925.

County	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Fresno	$0.545	$0.516	$0.825	$1.191	$1.293	$1.483	$1.068	$1.710	$1.162	$1.094
Kern	.423	.641	.893	1.252	1.350	1.714	1.211	.819	1.137	1.432
Los Angeles	.629	.651	1.176	1.340	1.380	1.532	1.403	.971	1.239	1.429
Orange	.512	.663	1.003	1.412	1.860	2.138	1.175	.880	1.183	1.417
San Luis Obispo		.450	.926	.905	1.040	1.400	.942	.600	.992	1.087
Santa Barbara	.611	.794	.808	1.235	1.125	1.575	1.011	.782	1.036	.914
Santa Clara	.666	.666	1.387	1.700	1.600	1.485	1.616	1.401	1.921	1.634
Ventura	.855	1.045	1.318	1.480	1.635	2.507	1.785	1.138	1.334	1.710
State average	$0.479	$0.636	$0.908	$1.278	$1.409	$1.726	$1.249	$0.923	$1.200	$1.422

For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil in the San Joaquin Valley fields. In 1919 and since, the average values have worked out at figures corresponding to quotations up to, in one year as high as 28° oil, due to the large yield of high-gravity oils from the new fields in the Los Angeles-Orange counties area.

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA.

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt counties. In the light of present-day developments, the following reference to the previous year's pro-

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duction of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

"It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate the wheels of commerce and set a trade at work excelling in variety any that has thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[1] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

[2] "Work was commenced in Pico Cañon in 1875, by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."

In 1877 Pico averaged 40-50 bbl. daily, and Ventura 80 bbl. daily. In 1878, there was some production (@ 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County; in 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County; but the production from the large number of new wells started in these new Los Angeles County fields did not reach its peak until August and September, 1923. Dominguez (Compton) came in during 1923; followed by Rosecrans and Inglewood in 1924. Ventura recorded important additions to its producing area in 1925.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

[1] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.
[2] *Idem*, p. 301.

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TABLE C.
Total Petroleum Production in California.

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	(a) 175,000	(b) $472,500	1902	14,356,910	$4,692,189
1876	12,000	30,000	1903	24,340,839	7,313,271
1877	13,000	29,250	1904	29,736,003	8,317,809
1878	15,227	30,454	1905	34,275,701	9,007,820
1879	19,858	39,716	1906	32,624,000	9,238,020
1880	40,552	60,828	1907	40 311,171	16,783,943
1881	99,862	124,828	1908	48,306,910	26,566,181
1882	128,636	257,272	1909	58,191,723	32,398,187
1888	142,857	285,714	1910	77,697,568	37,689,542
1884	262,000	655,000	1911	84,648,157	40,552,088
1885	325,000	750,750	1912	89,689,250	41,868,344
1886	(a) 377,145	(b) 870,205	1913	98,494,532	48,578,014
1887	678,572	1,357,144	1914	102,881,907	47,487,109
1888	690,333	1,380,666	1915	91,146,620	43,503,837
1889	303,220	368,048	1916	90,262,557	57,421,334
1890	307,360	384,200	1917	95,396,309	86,976,209
1891	323,600	401,264	1918	99,731,177	127,459,221
1892	385,049	561,333	1919	101,182,962	142,610,563
1893	470,179	608,092	1920	103,377,361	178,394,937
1894	783,078	1,064,521	1921	112,599,860	203,138,225
1895	1,245,339	1,000,235	1922	138,468,222	173,381,265
1896	1,257,780	1,180,793	1923	262,875,690	242,731,309
1897	1,911,569	1,918,269	1924	228,933,471	274,652,874
1898	2,249,088	2,376,420	1925	232,492,147	330,609,829
1899	2,677,875	2,660,793			
1900	4,329,950	4,152,928	Totals	2,319,955,491	$2,217,354,451
1901	7,710,315	2,961,102			

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.
[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

Well Data.

The following table is compiled from the monthly statements issued by the American Petroleum Institute:

TABLE D.
Well Operations by Fields, 1925.

Field	Wells producing Dec., 1924	Wells producing Dec., 1925	Wells completed during year	Daily initial output	Wells abandoned during year	Barrels per well produced per day Dec., 1924	Barrels per well produced per day Dec., 1925
Kern River	2,158	1,599	19	936	3	8.3	11,836
McKittrick	295	302	4	266	6	19.5	5.577
Midway-Sunset	2,940	2,906	182	51,795	37	36.2	92,292
Elk Hills	261	240	28	9,307	4	144.5	29,182
Lost Hills-Belridge	316	291	3	95	1	15.6	4,204
Coalinga	1,053	929	20	374	6	23.7	18,646
Wheeler Ridge	13	22	10	788	5	68.0	1,005
Watsonville	6	6				9.5	57
Santa Maria-Lompoc	301	251	9	1,395	5	24.8	5,614
Summerland	135	135				1.1	128
Ventura-Newhall	566	591	45	60,164	22	20.6	33,743
Los Angeles-Salt Lake	396	387	1	890	35	5.4	1,914
Whittier	178	189	7	682	9	11.0	2,008
Fullerton	389	401	7	5,755	2	23.6	13,958
Coyote	231	209	3	735	2	88.0	17,033
Santa Fe Springs	354	350	4	1,114	31	143.1	49,950
Montebello	160	163	8	1,233	5	109.3	18,102
Richfield	177	185	9	3,610	4	65.0	13,357
Huntington Beach	298	335	42	9,186	18	140.8	46,342
Long Beach	525	620	105	35,160	63	239.2	108,986
Torrance (Redondo)	510	603	111	14,241	57	88.1	31,515
Dominguez (Compton)	38	62	32	29,680	8	1,393.1	24,951
Rosecrans	17	113	113	76,638	12	449.3	24,582
Inglewood	2	171	178	202,458	15	50.5	62,904
*Newport		9	8	467	7		73
Miscellaneous drilling					122		
Totals	11,319	11,069	948	506,969	479	53.6	620,958

*Previous to April, 1925, Newport included in Huntington Beach.

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Specific Gravity of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E, following, for which we are indebted to the Standard Oil Company. Under present practice, oil below 18° Baumé may be considered as largely refinable for fuel oil and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County fields; Western Minerals area, south of Maricopa; Wheeler Ridge, Kern County.

TABLE E.

Production of Light and Heavy Oil, by Fields, 1925.

Field	Under 18° (barrels)	18° and over (barrels)	Total (barrels)
Kern River	5,964,465		5,964,465
Lost Hills-Belridge	428,420	1,325,811	1,754,231
McKittrick	2,122,123		2,122,123
Midway-Sunset	10,934,105	26,034,648	36,968,753
Elk Hills	1,197,638	10,819,361	12,016,999
Coalinga	3,877,777	3,915,981	7,793,758
Wheeler Ridge		344,646	344,646
Watsonville	23,725		23,725
Santa Maria	1,477,248	1,137,973	2,615,221
Summerland	41,790		41,790
Ventura-Newhall	66,892	9,211,247	9,278,139
Los Angeles-Salt Lake	723,035	2,113	725,148
Whittier-Fullerton	437,900	23,081,856	23,519,756
Santa Fe Springs		19,041,178	19,041,178
Huntington Beach	402,723	15,473,392	15,876,115
Long Beach	822,919	39,302,837	40,125,756
Torrance	3,028,123	10,248,055	13,276,178
Dominguez	30,762	13,317,517	13,348,279
Rosecrans		7,187,319	7,187,319
Inglewood	1,851,705	16,494,924	18,346,629
Miscellaneous	55,585	7,302	62,887
Totals	33,486,935	196,946,160	230,433,095

As previously noted by the writer,[1] a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1910, taking 18° Baumé as the dividing line. This subject has also been covered in detail and with charts, by Collom and Barnes.[2]

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low—25% high in 1914 to 25% low—75% high in 1921; 10% low—90% high in 1923; and 14% low—86% high in 1924–1925.

This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as well as its effect upon the relative situation between production and consumption. It has been a fortunate development, in view of the increased demand for

[1] Bradley, W. W., Mineral production of California in 1921: Cal. State Min. Bur., Report XVIII, p. 442, Sept. 1922.

[2] Collom, R. E., and Barnes, R. M., California oil production and reserves: Cal. State Min. Bur., Ninth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1923, pp. 5-23.

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refinery products (gasoline in particular), and a lessened demand for fuel oil during 1919–1922 at least, owing in part to the shutting down of the western copper smelters which are large consumers of California fuel oil.

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 153,795,682 barrels,[1] December 31, 1925, compared with 125,021,964 barrels on December 31, 1924, distributed as follows:

Stocks	*Dec. 31, 1925 (barrels)*	*Dec. 31, 1924 (barrels)*
Heavy Crude, heavier than 20° A.P.I., including all grades of fuel	82,849,057	57,254,796
Refinable Crude, 20° A.P.I., and lighter	44,345,837	40,574,578
Gasoline	10,172,562	10,957,487
Naphtha Distillates	6,548,483	9,396,613
All other stocks	9,879,743	6,838,490
Totals, all stocks	153,795,682	125,021,964

Operating Data.

The following tabulation (Table F) is compiled from data published by the Department of Petroleum and Gas,[2] semiannually, and here combined to show the entire year's operations for all fields. The districts are the geographical subdivisions as administered by the Department, and which are outlined on the accompanying map.

It will be noted that the state average yield of oil per well per day was 58.9 barrels for the first six months of 1925 and 64.1 barrels for the second. This is somewhat higher than the figure of 56.1 barrels average for December derived from American Petroleum Institute data as shown in Table D, on a preceding page, due in part at least, to the fact that the latter is on a full-time basis, whereas the Bureau figures allow for shut-down time.

[1] Standard Oil Bulletin, February, 1926, p. 13.
[2] Summary of operations, California Oil Fields: Cal. State Min. Bur., Eleventh Ann. Rep. of State Oil and Gas Supervisor, Aug., 1925, pp. 6-7; Feb., 1926, pp. 8-9.

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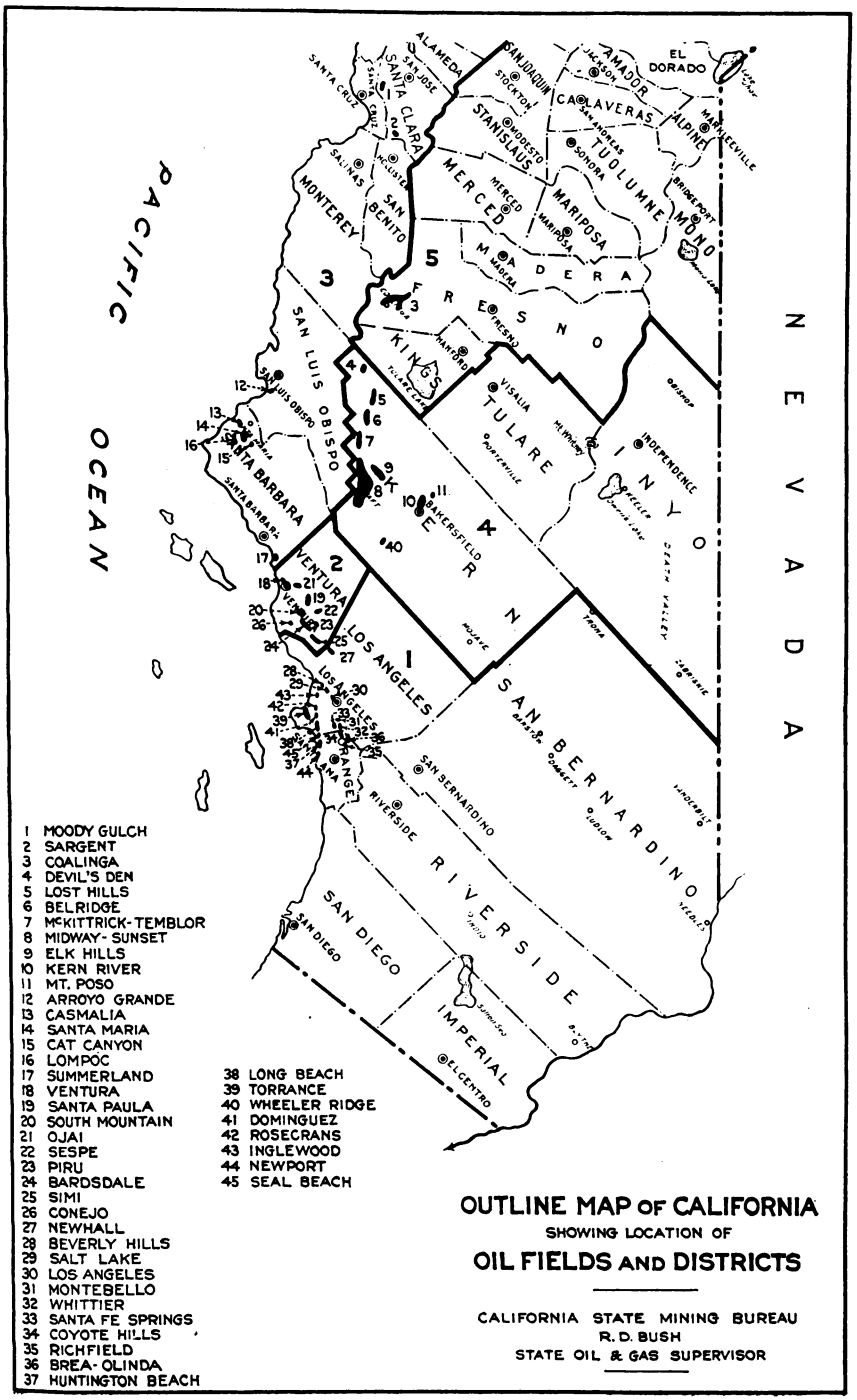

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TABLE F. Production Statistics and Operating Data of California Oil Fields—1925.

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
District No. 1:												
Beverly Hills	14	77,551	2,474	31.3	51.4	97.6	15	77,805	2,401	32.4	49.5	87.0
Brea Olinda	395	2,222,172	64,044	34.7	13.0	89.6	393	2,398,051	65,220	36.8	14.4	90.2
Coyote Hills	224	[a]3,778,599	39,029	96.8	33.6	96.3	218	3,511,808	38,257	91.8	34.1	95.4
Dominguez	57	8,304,626	9,331	890.0	25.1	90.4	66	5,213,775	11,022	473.0	27.0	90.8
Huntington Beach	330	[a]7,781,437	53,349	145.9	20.9	89.3	346	[b]8,522,295	57,851	147.3	27.4	90.9
Inglewood	31	2,620,186	3,749	698.9	6.3	66.8	156	15,751,350	25,748	611.8	22.5	89.7
Long Beach	539	[a]21,168,239	91,291	231.9	38.8	93.6	569	[b]19,395,621	97,355	199.2	52.2	93.0
Montebello	162	3,445,126	27,889	123.5	65.8	95.1	166	3,456,759	29,088	118.8	67.8	95.2
Newhall	76	40,998	12,863	3.2	6.0	93.5	78	[b]44,931	13,923	3.2	4.3	97.0
Newport	7	19,796	571	34.7	7.5	45.1	8	[b]17,523	935	18.7	13.8	63.5
Richfield	180	[a]2,072,658	30,151	68.7	10.0	92.5	182	2,413,321	31,496	76.6	6.8	94.1
Rosecrans	52	[a]3,337,838	7,780	429.0	20.9	82.7	102	[b]4,388,545	15,343	286.0	42.8	81.8
Salt Lake	85	197,364	14,826	13.3	24.7	96.4	82	191,253	14,156	13.5	24.2	93.8
Santa Fe Springs	379	[a]9,465,787	61,683	153.5	38.4	89.9	365	9,879,075	61,609	160.4	48.0	91.7
Torrance	582	[a]7,123,179	92,539	77.0	1.9	87.8	618	[b]6,112,088	101,500	60.2	2.4	89.3
Whittier	169	382,812	26,625	14.4	24.1	87.0	172	381,843	27,136	14.1	24.1	85.7
Totals	3,282	72,038,368	538,194	133.9	24.4	90.6	3,536	81,756,043	593,040	137.9	28.7	91.1
District No. 2:												
Bardsdale	144	177,466	25,532	7.0	1.4	97.9	147	186,769	26,455	7.1	1.0	97.8
Conejo	22	106	572	4.1	1.1	14.3	52	7,476	6,645	1.1	5.8	69.5
Ojai	69	37,149	11,910	3.1	1.9	95.4	70	36,305	12,146	3.0	2.1	94.3
Piru	80	61,546	13,319	4.6	12.0	92.0	93	64,611	14,219	4.5	15.4	83.1
Santa Paula	39	13,351	5,5[illegible]	2.4	0.3	78.5	31	11,223	5,084	2.2	2.0	89.1
Sespe	22	25,802	3,82[illegible]	6.7	0.9	96.7	24	22,875	4,295	5.3	0.7	97.3
Simi	51	29,796	8,05[illegible]	3.7	1.5	87.2	51	28,375	8,224	3.5	1.3	87.6
South Mountain	57	760,556	9,662	78.7	0.1	93.7	59	729,695	10,512	69.4	0.1	96.8
Ventura	40	2,590,585	6,365	407.0	56.8	87.9	56	4,438,160	8,291	535.3	38.9	80.5
Totals	524	3,696,357	84,778	43.6	6.9	89.4	583	5,525,489	95,871	57.6	6.9	89.4

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District No. 3:												
Arroyo Grande	19	15,756	3,165	5.0	4.6	92.0	19	13,834	3,063	4.5	4.5	87.6
Casmalia	94	471,056	15,370	30.6	216.4	90.3	72	286,143	11,288	25.3	222.5	85.2
Cat Canyon	37	301,965	5,970	50.6	11.7	89.1	38	362,446	6,026	60.1	10.3	86.2
*Half Moon Bay	4	*388	362	1.1	0.3	50.0	4	*388	368	1.1	0.3	50.0
Lompoc	1	18,995	181	104.9	1.2	100.0	1	18,460	184	100.3	0.9	100.0
Moody Gulch	3	330	513	0.6	0.3	94.5	3	*338	552	0.6	0.3	100.0
Santa Maria	155	562,750	22,007	25.6	37.1	78.7	157	573,365	22,576	25.4	39.3	78.2
Sargent	9	6,660	1,629	4.1	0.0	100.0	9	6,500	1,656	3.9	0.0	100.0
*Summerland	134	*26,100	22,305	1.2	12.9	92.0	134	*26,100	22,305	1.2	12.9	90.6
Totals	456	1,404,000	71,502	19.6	63.2	86.6	437	1,287,574	68,018	18.9	55.3	84.6
District No. 4:												
Belridge-Lost Hills-Devils Den	291	887,262	48,978	18.1	48.5	93.0	290	827,733	47,880	17.3	47.6	89.7
Elk Hills	278	6,782,071	46,546	145.7	8.9	92.5	241	5,229,126	39,696	131.7	8.1	89.5
Kern River	2,193	3,100,983	376,408	8.2	50.1	94.8	1,919	2,627,218	330,040	8.0	43.8	93.5
McKittrick-Temblor	303	1,066,365	52,440	20.3	67.7	95.6	304	1,078,301	53,209	20.3	77.0	95.1
Midway-Sunset	2,944	18,633,659	496,478	37.5	20.1	93.2	2,809	18,269,215	485,218	37.7	18.8	93.9
Wheeler Ridge	16	174,740	2,697	64.8	8.2	93.1	20	176,069	3,447	51.1	7.2	93.7
Totals	6,025	30,645,080	1,023,547	29.9	34.4	93.9	5,583	28,207,662	959,490	29.4	31.6	93.4
District No. 5:												
Coalinga	1,061	3,927,423	177,463	22.1	10.7	92.4	955	3,846,242	164,610	23.4	10.8	93.7
Grand totals	11,348	111,711,228	1,895,484	58.9	29.2	92.3	11,094	120,623,010	1,881,029	64.1	28.5	92.1

[a] The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Coyote Hills	2	500	60
Huntington Beach	5	10,332	79
Long Beach	47	228,114	1,257
Richfield	6	3,500	175
Rosecrans	5	57,088	80
Santa Fe Springs	6	9,930	112
Torrance	4	3,176	70

[b] The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Huntington Beach	2	8,935	199
Long Beach	10	254,140	1,323
Newhall	4	4,910	480
Newport	1	475	15
Rosecrans	2	18,860	224
Torrance	4	25,145	666

*Estimated.

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Financial and Operating Conditions of California Oil Fields, 1925.

Financial results of the oil business during 1925 are shown by the following tables. The features worthy of mention are: (1) The higher price received for the year as shown by the state average of all grades, but especially the lighter gravities. (2) Increases in the dividends paid by companies operating in Los Angeles County, and in the Kern River and Midway fields, and an increase in the state total of dividends for the year. (3) Decreases in the number of barrels per well per day yield (see Table I) in most of the older fields. (4) Somewhat higher operating costs per barrel in most of the fields.

With reference to Table I, it should be noted that although it lacks data from the larger operators who have refineries and with interests in more than one field, yet the data given are of economic value and interest in that they indicate the conditions prevailing among the smaller companies and operators.

Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high-grade oil, and proximity to market. Price and profits have usually been greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil. Crude oil testing as high as 56° Baumé is obtained from some of the Ventura wells.

TABLE G. CAPITALIZATION.

Field	Number of companies considered*	Per cent of total product of field	Capital	
			Cash	Property
Fresno County—Coalinga	51	30	$2,329,181	$20,704,399
Kern County:				
Kern River	49	35	8,069,225	5,320,188
Midway	58	37	4,852,681	40,003,673
Sunset and Maricopa	27		1,703,155	4,010,165
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	38	12	3,025,038	3,232,748
Los Angeles County	98	24	48,085,433	29,136,859
Orange County	44	43	5,042,395	11,204,504
Santa Barbara County	24	30	2,865,348	14,098,562
Ventura County	34	24	2,100,167	14,958,883
Subtotals	423	--	$78,072,623	$142,669,981
Miscellaneous and marketing companies[a]	92	56	378,471,264	155,819,413
Totals	515	----------	$456,543,887	$298,489,394

* See Table I, following.

[a] Includes companies having refineries, and those operating in several fields whose data could not be segregated as to counties or fields.

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TABLE H. Dividends Paid by Oil Companies. 1920-1925.

Field	1920		1921		1922		1923		1924		1925	
	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value
Coalinga	29	$1,297,694	24	$1,142,767	20	$893,210	17	$383,675	13	$239,985	20	$815,625
Kern River	26	783,625	28	390,794	20	594,306	13	187,170	20	67,468	20	1,083,147
Midway	39	7,096,819	34	4,311,539	30	2,706,985	19	2,438,695	31	3,528,930	27	5,078,020
Sunset, Maricopa and Wheeler Ridge	14	691,611	18	960,459	19	936,174	11	259,569	13	739,494	13	306,089
McKittrick, Belridge, Lost Hills, Devils Den, Elk Hills	12	1,231,045	13	2,603,490	10	733,460	11	1,021,602	5	1,594,497	6	762,526
Santa Barbara County	7	312,332	5	400,535	5	317,014	3	163,600	3	221,916	2	124,267
Ventura County	5	559,942	6	1,362,210	7	1,204,631	4	126,784	4	303,000	5	438,497
Los Angeles County	20	3,282,497	11	562,224	16	1,442,470	32	5,627,346	34	3,458,221	36	9,172,047
Orange County			11	1,395,158	8	331,345	12	897,119	11	2,717,050	15	1,194,391
Subtotals	152	$15,255,565	150	$13,129,176	135	$9,159,595	122	$11,105,560	134	$12,870,561	144	$18,974,519
Miscellaneous and marketing companies [a]	9	31,072,321	11	35,886,119	10	41,030,594	10	44,398,555	36	52,150,372	27	53,459,294
Totals	161	$46,327,886	161	$49,015,295	145	$50,190,189	132	$55,504,115	170	$65,020,933	171	$72,433,813

[a] See Table G, preceding.

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TABLE I. Average Prices of Light and Heavy Oils, and Operating Data, 1925.

Field	Price				Operating data					
					All companies considered *			Dividend companies [a]		
	Under 18° Baume	18° and over	Average price	Price to dividend companies	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel
Fresno County—										
Coalinga	$1.080	$1.181	$1.094	$1.101	15.9	$6.58	$0.414	18.0	$6.98	$0.388
Kern County—										
Kern River	1.087		1.087	1.075	8.3	3.32	0.400	6.9	2.13	0.308
Midway	1.070	1.660	1.590	1.668	44.3	18.25	0.412	45.0	16.92	0.376
Sunset and Maricopa	1.129	1.372	1.205	1.240	20.35	7.98	0.392	18.72	7.41	0.396
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	1.100	1.428	1.283	1.108	20.3	7.31	0.360	21.1	5.84	0.277
Los Angeles County	1.057	1.434	1.429	1.422	110.2	52.41	0.476	118.8	51.44	0.433
Orange County	1.190	1.421	1.417	1.414	92.6	56.83	0.614	90.9	54.46	0.599
Santa Barbara County	0.766	1.190	0.914	1.005	32.3	18.48	0.572	43.4	6.47	0.149
Ventura County	1.135	1.715	1.710	1.717	45.4	24.45	0.539	57.46	38.44	0.669

*See Table G, preceding. Does not include companies with refineries, nor those operating in several fields whose data could not be segregated as to counties or fields. The data given are of value, however, as showing the conditions obtaining among the smaller operators.

[a] See Table H, preceding.

It should be noted that in the case of a county like Ventura, with only a few producers, the averages are not so significant as in other fields with a large number of operators. The figures of a single large operator in such a case can materially affect the general average if they should be much above or below the average of the others.

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Proved Oil Land.

The total proved oil land of the state increased to 121,436 acres, as against 118,979 acres in 1924. Of this 1925 total, 22,673 acres being owned by federal, state and city governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1925 was distributed by counties as follows:

TABLE J.

Proved Oil Lands and Number of Wells, 1925.

County	*Land (acres)*	*Number wells*
Fresno	14,636	969
Kern	76,398	5,931
*Los Angeles	11,239	2,807
Orange	6,630	979
San Bernardino	------	1
San Luis Obispo	402	11
San Mateo	------	3
Santa Barbara	7,823	354
Santa Clara	80	9
Ventura	4,228	571
Totals	121,436	11,635

*Not including the old Los Angeles City field.

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CHAPTER THREE.

METALS.

Bibliography: Reports of State Mineralogist I–XXI (inc.). Bulletins 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95. Spurr and Wormser, "Marketing of Metals and Minerals." See also under each metal.

The total value of metals produced in California during 1925 was $24,403,794. The chief of these is, and always has been, gold, followed in 1925 by copper, silver, zinc, lead, quicksilver, tungsten, platinum and manganese ore. There was a small output of iron ore and antimony. There was no production of arsenic, cadmium, molybdenum, nor tin which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the state; although there has yet been no commercial output of them. The above-noted total for this group is a net increase of $4,395,020 over the 1924 total of $24,008,774, due mainly to increases registered by lead and zinc, in spite of decreases by copper, gold and silver.

California leads all states in the Union in her gold production and is credited with approximately 30% of the nation's yield in 1925. The precious metal is widely distributed through the state. Thirty-four of the fifty-eight counties reported an output in 1925 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties; and the southern belt, in San Bernardino, Riverside and San Diego counties.

Silver is not generally found alone in the state, except notably in the Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead, and zinc.

Quicksilver has for many years been one of the state's staple products and California has supplied approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.

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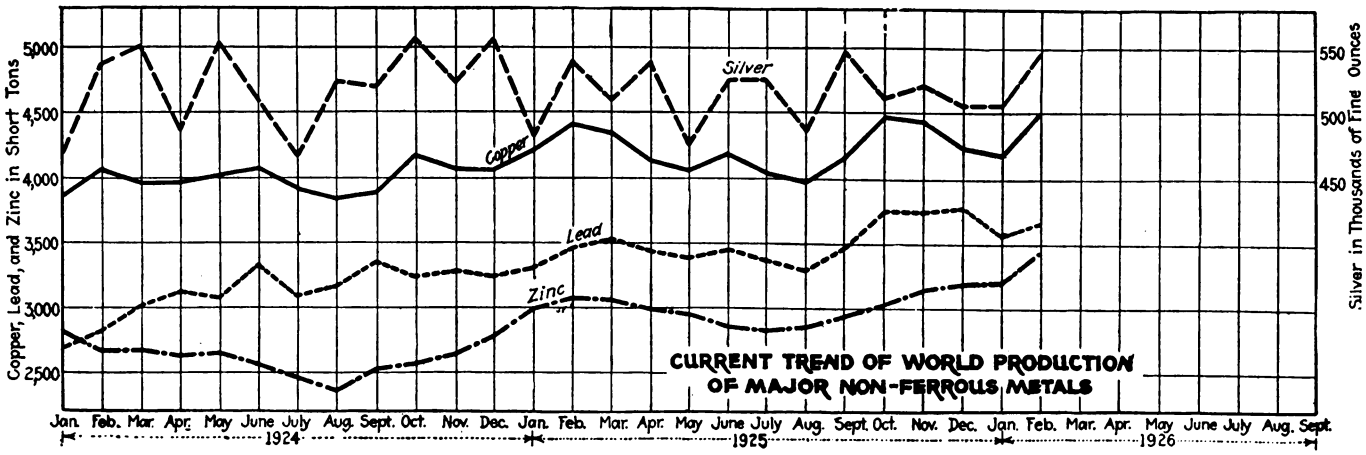

These curves are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1923 and 1924 about 97 per cent of the world's output of copper; 78.5 per cent of the lead; 87.5 per cent of the zinc and 81 per cent of the silver.—Eng. Min. Jour.-Press, April 3, 1926.

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A comparison of the 1925 metal output with that of the 1924 is afforded by the following table:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Copper	52,089,349 lbs.	$6,823,704	46,968,499 lbs.	$6,669,527	$154,177—
Gold		13,150,175		13,065,330	84,845—
Lead	4,984,387 lbs.	398,751	7,352,722 lbs.	639,661	240,910+
Manganese ore	1,115 tons	25,785	832 tons	19,450	6,335—
Platinum	273 fine oz.	36,452	292 fine oz.	39,937	3,485+
Quicksilver	7,948 flasks	543,080	7,683 flasks	621,831	78,751+
Silver	3,555,153 fine oz.	2,381,952	3,054,416 fine oz.	2,119,765	262,187—
Tungsten concentrates	781 tons	446,009	573 tons	348,471	97,538—
Zinc	3,060,000 lbs.	198,900	11,546,602 lbs.	877,542	678,642+
Unapportioned*		3,966		2,280	1,686—
Total value		$24,008,774		$24,403,794	
Net increase					$395,020+

*Includes iron ore and arsenic in 1924; iron ore and antimony in 1925.

ALUMINUM.

Bibliography: Report XVIII, p. 198. Bulletins 38, 67. U. S. Geol. Surv., Min. Res. of U. S.

To date there has been no commercial production of aluminum ore in California. Only a single authenticated occurrence of bauxite has thus far been noted in this state, being in Riverside County, southeast of Corona, but as yet undeveloped.

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence, commercially, in the production of the metal: bauxite (to which may be added the related hydrated oxides, hydrargillite and diaspore) and cryolite. Cryolite is found in commercial quantities only in South Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been, for some years, the most important source of aluminum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0%–10%. Besides its reduction to the metal, bauxite is also utilized in the manufacture of aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive; and in the refining of oil (stated to be of great importance). The most important producing countries, both of bauxite and the metal, are the United States and France, the former yielding more than 60 per cent of the world's output. In 1913 France led.

ANTIMONY.

Bibliography: State Mineralogist Reports VIII, X, XII, XIII, XIV, XV, XVII. Bulletin 38.

Production of antimony in California has been irregular, and small in amount except during 1915–17 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony in California has come from Kern, Inyo and San Benito counties, and

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other occurrences have been noted in Nevada, Riverside and Santa Clara counties. The commonest occurrence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

Californian producers claim that they can not operate profitably unless the price of antimony be above 12 cents per pound. Present New York quotations are around 17 cents per pound, owing to a shortage of the metal as a result of the rioting and revolutionary fighting that has been going on in China for the past two years. China is the principal world source of antimony. As a consequence, there is again some revival of antimony mining in California.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper).

Antimony Production of California, by Years.

The production of antimony in California by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1900	70	$5,700
1888	100	20,000	1901	50	8,350
1889			1902		
1893	50	2,250	1915	510	35,666
1894	150	6,000	1916	1,015	64,793
1895	33	1,485	1917	158	18,786
1896	17	2,320	1918		
1897	20	3,500	1925	*	*
1898	40	1,200			
1899	75	13,500	Totals	2,363	$199,050

*Under 'Unapportioned.'

ARSENIC.

Bibliography: Report XVIII. Bulletin 67. U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing; and in scorodite ($FeAsO_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic,' for which there is a demand for the preparation of insecticides, for use in agriculture and horticulture, and especially against the cotton-boll weevil in the southern states.

Up to the beginning of 1924, there had been no commercial recovery of arsenic from Californian ores. In that year the plant of the Chipman Chemical Company at Bay Point began the preparation of arsenic compounds from Californian and Nevadan ores, by a chemical process, but the plant burned late in the year and has not since been rebuilt.

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BERYLLIUM.

Bibliography: Eng. & Min. Jour.-Press, Vol. 118, No. 8, p. 285, Aug. 23, 1924.

Beryllium is a metal resembling aluminum closely in its chemical character, and has a specific gravity of 2.7. Several alloys have been prepared experimentally, of which copper-beryllium has received the most attention. The addition of 5% beryllium produces a golden-yellow alloy.

The compounds of beryllium at present used commercially are the nitrate and oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton, the amount varying from 2 gm. to 5 gm. per kilogram of thorium nitrate. The oxide has been added to materials being used for the manufacture of abrasive compounds and in dental cements, and has also been recommended as a condensing agent in the preparation of certain esters. It is stated that this latter property may prove of value to manufacturers of synthetic perfumes and essences. Beryllium sulphate has been used to some extent in medical research.

There are a number of beryllium minerals, but none have been found in commercial quantities, except beryl, which is a beryllium-aluminum silicate carrying, when pure, 57% silica, 19% alumina, and 14% beryllium oxide. Beryl suitable for commercial purposes should carry from 10% to 12% beryllium oxide. The ore before use is ground to pass 90%–95% through a 200-mesh screen. It should be white in color, free from iron-bearing minerals and metallic iron. The price varies from 4¢ to 5¢ per pound in carload lots, according to demand and percentage of beryllium oxide. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum. For this reason, the mineral phenacite (Be_2SiO_4) would be a more desirable source for the metal, and it carries aproximately 45% beryllium oxide.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside counties. Thus far there have been no commercial shipments of beryl except for gem purposes (the pink and aquamarine varieties.)

BISMUTH.

Bibliography: Bulletins 38, 67. Am. Jour. Sci. 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County.

In 1917, a few pounds of bismuthinite (Bi_2S_3) with associated bismutite ($Bi_2CO_5H_2O$), was taken out at the United Tungsten Copper Mine, in the Morongo district, San Bernardino County. It is associated with scheelite in a contact deposit between limestone and granite.

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Recovery of bismuth from blister copper in the electrolytic refinery has been noted,[1] ranging as high as 27.3 pounds of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining of lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

Present quotations for bismuth are around $2.70 per pound for the refined metal.

CADMIUM.

Bibliography: U. S. Geol. Surv., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only, commercial production of cadmium recorded from Californian ore. Cadmium there occurs associated with zinc sulphide, sphalerite, probably as the sulphide, greenockite. Cadmium also occurs in the Cerro Gordo Mine, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute proportions, the average ratio being about 1 of cadmium to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are 60¢ per pound for the refined metal.

COBALT.

Bibliography: Report XIV. Bulletin 67. U. S. G. S., Min. Res. of U. S., 1912, 1918.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial production has resulted. Some of the copper ores of the foothill copper belt in Mariposa and Madera counties have been found to contain cobalt up to 3%. The most recent and notable occurrence thus far found in

[1] Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217-218.

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this state is in the Mar-John Mine near Sheep Ranch, Calaveras County. Lenses of smaltite ($CoAs_2$) have been uncovered in the vein, there, and several tons taken out in the course of development work; but as yet there have been no commercial shipments.

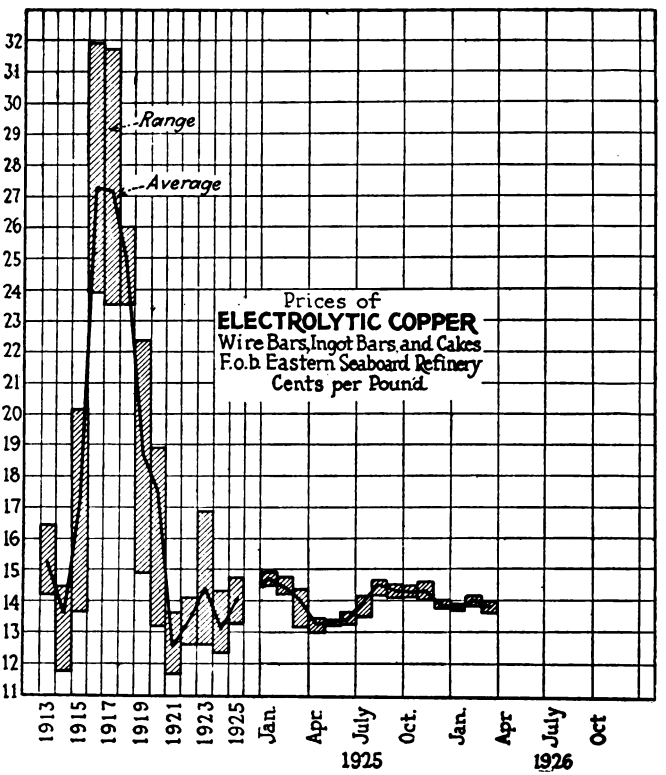
The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

Present quotations for cobalt are $2.50 per pound for the refined metal.

COPPER.

Bibliography: State Mineralogist Reports VIII–XXII (inc.). Bulletins 23, 50, 91.

Copper is second only to gold among the metals produced in California. The output for 1925 amounted to a total of 46,968,499 pounds



From Engineering and Mining Journal-Press, April 3, 1926.

of recoverable metal valued at $6,669,527, a slight decrease from the 1924 figures of 52,089,349 pounds and $6,823,704. The average price for 1925 being higher (14.2¢ against 13.1¢ per pound) than in 1924,

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the drop in total value was not as great in proportion as the decrease in quantity. The average price in 1923 was 14.7¢ per pound.

As for several years past, Plumas County ranked first for 1925 with an output of 26,950,029 pounds; Shasta second, with 14,565,967 pounds; and Calaveras third, with 4,906,650 pounds.

Distribution of the 1925 copper output, by counties, was as follows:

Copper Production, by Counties, 1925.

County	*Pounds*	*Value*
Calaveras	4,906,650	$696,744
Inyo	73,003	10,367
Mono	1,020	145
Plumas	26,950,029	3,826,904
Riverside	23,134	3,285
San Bernardino	6,249	888
Shasta	14,565,967	2,068,367
Trinity	439,766	62,447
Amador, Butte, Kern, Lake, Los Angeles, Nevada, Orange, Placer*	2,681	380
Totals	46,968,499	$6,669,527

*Combined to conceal output of a single operator in each.

Copper Production of the United States.

According to preliminary data issued by the U. S. Bureau of Mines,[1] the smelter production of primary copper from domestic sources during 1925 amounted to 1,674,869,886 pounds, an increase of approximately 2%. The value of smelter production increased approximately 11% in 1925. The average price of 2,634,000,000 pounds of copper delivered during the year, as reported to the Bureau by selling agencies, was 14.2¢ per pound.

"REFINED COPPER.

"The total production of new refined copper in 1925 was 2,205,000,000 pounds, a decrease of 55,000,000 pounds over that in 1924.

"Primary and secondary copper produced by regular refining plants and imported, 1924-1925, in pounds:

	1924	*1925*
"Primary:		
Domestic:[a]		
Electrolytic	1,499,223,447	1,533,995,439
Lake	145,333,227	138,029,764
Casting	29,657,925	10,870,144
	1,674,214,599	1,682,895,347
Foreign:[a]		
Electrolytic	577,100,034	516,632,530
Casting	8,761,377	5,045,947
Refinery production of new copper	2,260,076,010	2,204,573,824
Imports of refined copper	145,909,968	99,773,546
Total new refined copper made available	2,405,985,978	2,304,347,370
Secondary:		
Electrolytic	104,281,430	140,340,541
Casting	50,536,678	58,010,653
	154,818,108	198,360,194
	2,560,804,086	2,502,707,564

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation of the amounts at this stage of manufacture is not possible.

"In addition to their output of metallic copper the regular refining companies produced bluestone (hydrous copper sulphate) having a copper content of 6,754,000 pounds, as compared with 5,766,000 pounds in 1924.

[1] U. S. Bureau of Mines, Press Bulletin, June 30, 1926.

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"STOCKS.

Stocks of Copper, January 1, 1921, 1922, 1923, 1924, 1925 and 1926, in Pounds.

Year.	Refined copper	Blister and material in process of refining [b]
1921	659,000,000	465,000,000
1922	459,000,000	283,000,000
1923	216,000,000	361,000,000
1924	264,000,000	432,000,000
1925	243,000,000	393,000,000
1926	124,000,000	432,000,000 [a]

[a] Subject to revision. [b] The amounts stated in the last column in the table above do not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States."

Copper Production of California by Years.

Although some mining of copper ores in a small way had been done earlier, shipments in appreciable quantities began in 1861 and continued of importance up to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or 'regulus'[1] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity in Calaveras County, with some shipments also made from Mariposa, El Dorado, Fresno, and San Luis Obispo counties. From 1868 to 1882, the output was insignificant. There are wide discrepancies in the figures currently recorded for copper production previous to 1882 in which year the data of the U. S. Geological Survey began. The detailed statistics of the California State Mining Bureau began in the year 1894.

Amount and value of copper production in California annually since 1882 is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1905	16,997,489	$2,650,605
1883	1,600,862	265,743	1906	28,726,448	5,522,712
1884	876,166	120,911	1907	32,602,945	6,341,387
1885	469,028	49,248	1908	40,868,772	5,350,777
1886	430,210	43,021	1909	65,727,736	8,478,142
1887	1,600,000	192,000	1910	53,721,032	6,680,641
1888	1,570,021	235,303	1911	36,838,024	4,604,753
1889	151,505	18,180	1912	34,169,997	5,638,049
1890	23,347	3,502	1913	34,471,118	5,343,023
1891	3,397,405	424,675	1914	30,491,535	4,055,375
1892	2,980,944	342,808	1915	40,968,966	7,169,567
1893	239,682	21,571	1916	55,809,019	13,729,017
1894	738,594	72,486	1917	48,534,611	13,249,948
1895	225,650	21,901	1918	47,793,046	11,805,883
1896	1,992,844	199,519	1919	22,162,605	4,122,246
1897	13,638,626	1,540,666	1920	12,947,299	2,382,303
1898	21,543,229	2,475,168	1921	12,088,053	1,559,358
1899	23,915,486	3,990,534	1922	22,883,987	3,090,582
1900	29,515,512	4,748,242	1923	28,346,860	4,166,989
1901	34,931,788	5,501,782	1924	52,089,349	6,823,704
1902	27,860,162	3,239,975	1925	46,968,499	6,669,527
1903	19,113,861	2,520,997			
1904	29,974,154	3,969,995	Totals	982,823,161	$159,577,487

[1] Brown, J. Ross, Mineral Resources west of the Rocky Mountains, p. 168, 1867.

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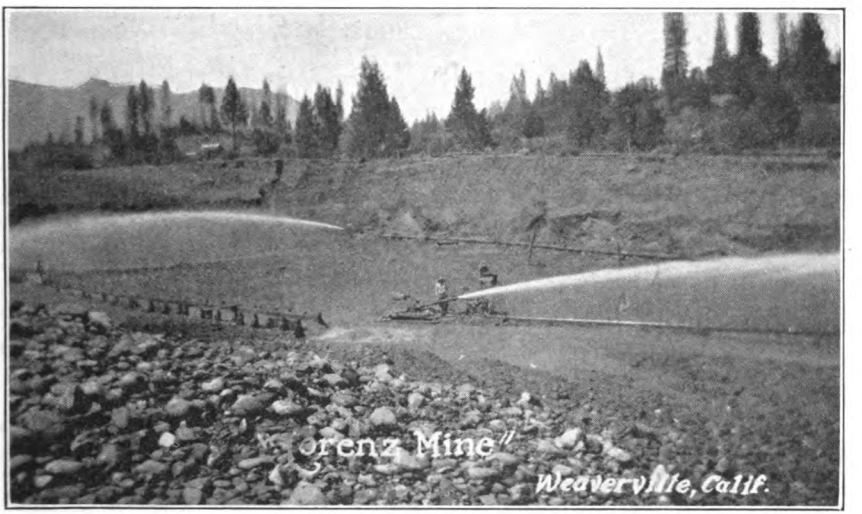
GOLD.

Bibliography: State Mineralogist Reports I to XXII (inc.). Bulletins 36, 45, 57, 91, 92. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first, and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement beginning with 1920, it still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska. In fact, at present, California is producing approximately 30% of the gold mined in the entire United States.

While there is some renewal of activity in the development of gold lode properties, it has not yet become reflected in an increased yield of the metal. The 1925 figures show a slight decrease from the 1924 yield, but practically holding its own the past three years.



Lorenz Hydraulic mine, near Weaverville, Trinity County. Photo by C. A. Logan.

The production of gold in California in 1925 totaled 632,035.31 fine ounces, worth $13,065,330, being a decrease of 4,104.41 fine ounces from the 1924 yield. This was divided, $7,969,186 from the 'deep' or lode mines, and $5,096,144 from placers (mainly by the dredgers). As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1925 is reported from Yuba County, with an output of 124,354.23 fine ounces ($2,570,630); Amador County, with 113,105.63 ounces ($2,338,101), was second; Nevada County, with 111,533.74 ounces ($2,305,607), third; followed by Sierra and Sacramento in fourth and fifth places respectively. It will be noted that Yuba County regained its place in first rank which it surrendered to Nevada County in 1924. The Yuba County production is almost

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entirely from dredges, while that from Nevada County is mainly lode gold.

Distribution of the 1925 gold production, by counties, was as follows:

Gold Production, by Counties, 1925.

County.	*Value.*	*County.*	*Value.*
Alpine	$219	Nevada	$2,305,607
Amador	2,338,101	Orange	52
Butte	355,289	Placer	121,785
Calaveras	652,433	Plumas	249,540
Del Norte	681	Riverside	3,687
El Dorado	40,212	Sacramento	1,302,320
Fresno	25,056	San Bernardino	157,374
Humboldt	13,142	San Diego	5,134
Inyo	43,774	San Luis Obispo	840
Kern	135,545	Shasta	235,013
Lassen	1,130	Sierra	1,373,705
Los Angeles	409	Siskiyou	180,120
Madera	2,366	Stanislaus	171,742
Mariposa	192,810	Trinity	424,037
Merced	289	Tuolumne	155,592
Mono	5,503	Yuba	2,570,630
Monterey	998		
Napa	195	Total value	$13,065,330

The following is quoted from the advance chapter on Gold in 1925, by courtesy of Mr. J. M. Hill of the U. S. Bureau of Mines:

"The value of gold produced in California in 1925 was $13,065,330, a decrease of 0.65 per cent as compared with 1924. Deep mines produced 61 per cent and placer mines 39 per cent of the total gold in 1925 as compared with 65 per cent and 35 per cent respectively, in 1924.

"Five counties produced more than $1,000,000 in gold in 1925. Yuba, with $2,570,630 produced largely by dredges, was first in rank; Amador with $2,338,101 almost entirely from gold quartz mines, was second; Nevada with $2,305,607 from gold quartz and a few placer mines, was third; Sierra with $1,373,705 from gold quartz and hydraulic mines was fourth, and Sacramento with $1,302,320 entirely from placer mines, was fifth. The next largest production of gold, $652,433, came from Calaveras County, largely from gold quartz mines and one dredge operation, followed by Trinity County with $424,037 largely from dredge and hydraulic placer mines.

"In 1925 there were 41 companies in the State that produced in excess of 1,000 ounces of gold and contributed 90 per cent of the total gold output of the State. Of these 8 produced in excess of 20,000 ounces and 4 in excess of 50,000 ounces. Of these companies 12 operated gold dredges, 1 operated a lead and 1 a silver mine, 3 operated copper mines, and 24 operated gold quartz mines. The 10 largest gold-producing companies in 1925, in order of output, were the Yuba Consolidated Gold Fields (6 dredges), Natomas Co. of California (8 dredges), Empire Mines Co. (gold quartz), Sixteen to One Mine Co. (gold quartz), Kennedy Mining & Milling Co. (gold quartz), North Star Mines Co. (gold quartz), Argonaut Mining Co. (gold quartz), Carson Hill Gold Mines (Inc.) (gold quartz), Central Eureka Mining Co. (gold quartz), and the Walker Mining Co. (copper ore).

"The yield of gold from placer mines in 1925 was valued at $5,096,144, an increase of 11 per cent as compared with 1924. There was an increased gold yield of 10 per cent by dredges and 191 per cent by hydraulic mines, but decreases of 33 per cent and 17 per cent by drift and surface mines, respectively, as compared with 1924. In 1925 dredges produced 93 per cent, drift mines slightly over 1 per cent, hydraulic mines nearly 4 per cent, and surface placers 2 per cent of the gold produced from placer deposits. Placer mines of Yuba County increased their gold production by $575,138, Sacramento County by $151,633, Siskiyou County by $33,229, Humboldt County by $11,873, and Nevada County by $10,115, as compared with 1924, and the placer mines of Amador, Mariposa, Placer, and Sierra counties increased their output by more than 3,000 each. There were slight increases in placer yield from Inyo, Plumas, San Diego, and Trinity counties. The gold produced at placer mines declined in Butte County by $193,015, Calaveras County by $40,874, Shasta County by $31,572, and Stanislaus County by $24,277, as compared with 1924. In Fresno, Kern, Madera, and Tuolumne counties there was less placer gold produced than in the previous year. Production of gold by 24 dredges in 1925 was $4,750,842, an increase of $445,321 as compared with 1924. There was an increased production by dredges in Sacramento and Yuba counties, but declines in the gold yield from dredges in Butte, Calaveras, Placer, Shasta, Stanislaus, and Trinity counties. Gold produced at 71 drift mines in 1925 was valued at $66,523, a decrease of $32,045 as compared with 1924. Increases of gold output from drift mines was recorded from El Dorado, Placer, Shasta, Trinity, and Yuba counties, but decreases from drift mines in Butte, Calaveras, Mariposa, Nevada, Plumas, Sierra, and Tuolumne counties. Drift mines in Sacramento County were productive in 1925, but not in 1924. Gold produced at 98 hydraulic mines in 1925 was valued at $175,345, an increase of $115,150 as compared with 1924. The gold production at hydraulic mines increased in Siskiyou County by $31,644, in Trinity County by $25,196, in Sierra County by $18,343, in Nevada County by $15,321, in Humboldt by $12,569, and by less than $10,000 in Amador, Plumas, and Shasta counties. Gold produced by 166 surface or sluice operations in 1925 was valued at $103,434, a decrease of $20,654 as compared

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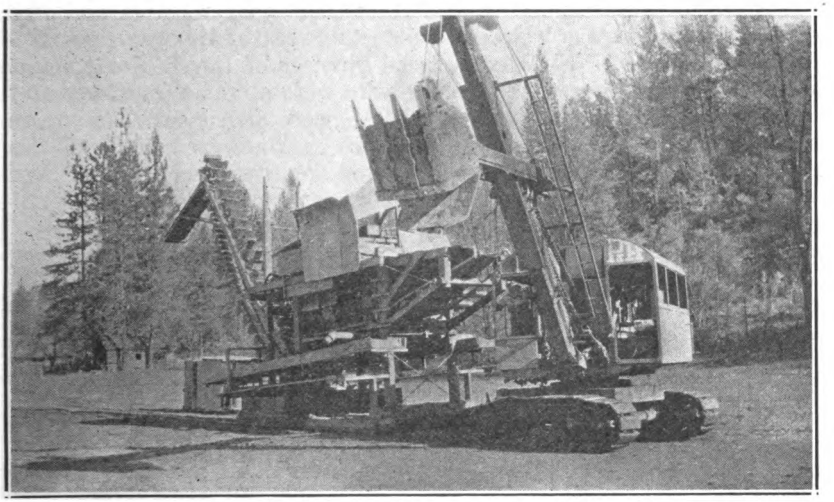
with 1924. In practically all the mining counties of the State gold is recovered by itinerant placer prospectors and it is very difficult to apportion properly the gold produced by these floating miners.

"The production of gold from 332 deep mines in California in 1925 was valued at $7,969,186, a decrease of 7 per cent as compared with 1924. The deep mines of Amador and Nevada counties produced over $2,000,000 in gold, of Sierra County over $1,000,000 in gold, of Calaveras County over $500,000 in gold, and of Plumas County over $200,000 in gold. Over $100,000 in gold was produced by deep mines in Mariposa, Shasta, San Bernardino, Tuolumne, Kern, Siskiyou, and Butte counties. Deep mines of Nevada County produced $524,840 less gold, of Amador County $375,401 less gold, and of Calaveras County $160,654 less gold than in 1924. There was a decreased yield of more than $25,000 by the deep mines in Plumas, San Bernardino, Mono, Shasta, and Tuolumne counties. Large increases of value in gold were recorded from deep mines in Sierra County, $569,262, Siskiyou County, $83,321, and Butte County, $63,774. Gold ore and tailings yielded 93 per cent, copper ore and tailings 4 per cent, silver ore and tailings 2 per cent, and lead and zinc ores 1 per cent of the total deep-gold production. Of the gold recovered from ore and tailings in 1925, 72 per cent was recovered by amalgamation, 16 per cent by cyanidation, and 12 per cent by smelting."



P. and H. gasoline steam-shovel and Pierce gravel gold-washing machine on Jenkins & Taylor Placer near French Gulch, Shasta County. Photo by courtesy of Clifford Taylor.

Total Gold Production of California.

The presence of gold in stream gravels near Los Angeles was known and worked in a small way by the Indians, at least as early as 1841,[1] and possibly 1820.[2] On March 2, 1844, Don Manuel Castanares, deputy for California to the Congress of Mexico, reported[3] to his government that placers near Los Angeles had produced up to December, 1843, a total of 2000 ounces of gold dust, most of which had been sent to the United States mint at Philadelphia.

As the padres and the rancheros discouraged the quest of gold this early, small production caused no particular excitement. It was not until James W. Marshall's finding of gold nuggets in the tail-race of Sutter's saw mill on the American River, January 24, 1848, was heralded abroad that the great rush began, and California became a commonwealth of first rank almost over night. There are, however, no authentic data on gold production prior to 1848, other than occasional, scattered references such as above quoted.

[1]Hittell, T. H., History of California: Vol. II, p. 312, 1885.
[2]Bancroft, H. H., History of California: Vol. II, p. 417, 1886.
[3]Mercantile Trust Review of the Pacific, Vol. XIV, No. 2, p. 43, Feb. 15, 1925.

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The following table was originally compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures for 1903–1923 (inclusive), are those prepared by the U. S. Geological Survey; and since by the U. S. Bureau of Mines:

Year	Value	Year	Value
1848	$245,301	1888	$12,750,000
1849	10,151,360	1889	11,212,913
1850	41,273,106	1890	12,309,793
1851	75,938,232	1891	12,728,869
1852	81,294,700	1892	12,571,900
1853	67,613,487	1893	12,538,780
1854	69,433,931	1894	13,863,282
1855	55,485,395	1895	15,334,317
1856	57,509,411	1896	17,181,562
1857	43,628,172	1897	15,871,401
1858	46,591,140	1898	15,906,478
1859	45,846,599	1899	15,336,031
1860	44,095,163	1900	15,863,355
1861	41,884,995	1901	16,989,044
1862	38,854,668	1902	16,910,320
1863	23,501,736	1903	16,300,653
1864	24,071,423	1904	18,633.676
1865	17,930,858	1905	18,898,545
1866	17,123,867	1906	18,732,452
1867	18,265,452	1907	16,727,928
1868	17,555,867	1908	18,761,559
1869	18,229,044	1909	20,237,870
1870	17,458,133	1910	19,715,440
1871	17,477,885	1911	19,738,908
1872	15,482,194	1912	19,713,478
1873	15,019,210	1913	20,406,958
1874	17,264,836	1914	20,653,496
1875	16,876,009	1915	22,442,296
1876	15,610,723	1916	21,410,741
1877	16,501,268	1917	20,087,504
1878	18,839,141	1918	16,528,953
1879	19,626,654	1919	16,695,955
1880	20,030,761	1920	14,311,043
1881	19,223,155	1921	15,704,822
1882	17,146,416	1922	14,670,346
1883	24,316,873	1923	13,379,013
1884	13,600,000	1924	13,150,175
1885	12,661,044	1925	13,065,330
1886	14,716,506		
1887	13,588,614	Total value	$1,789,298,515

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IRIDIUM (see under Platinum).

IRON ORE.

Bibliography: State Mineralogist Reports II, IV, V, X, XII–XV (inc.), XVII, XVIII, XXI. Bulletins 38, 67, 91. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123, pp. 94–96, 113–114.

A small tonnage of iron ore was produced in California during the year 1925, and utilized for foundry flux and in steel refining at open-hearth plants. As there was only a single operator, the figures are concealed under the 'unapportioned' total. There is also some tonnage utilized in the manufacture of paint pigment, and which is credited to 'mineral paint' in these statistical reports.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside and San Bernardino counties, but production has so far been limited for lack of an economic supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction; also, ferrochrome, ferromanganese, and ferrosilicon have been made in California.

Total Iron Ore Production of California.

Total iron ore production in California, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1912	2,508	$2,508
1882	2,073	17,766	1913	2,343	4,485
1883	11,191	106,540	1914	1,436	5,128
1884	4,532	40,983	1915	724	2,584
1885			1916	3,000	6,000
1886	3,676	19,250	1917	2,874	11,496
1887			1918	3,108	15,947
1893	250	2,000	1919	2,300	13,796
1894	200	1,500	1920	5,975	40,889
1895			1921	1,970	12,030
1907	400	400	1922	3,588	18,868
1908			1923	3,102	18,665
1909	108	174	1924 } [a] 1925 }	785	4,710
1910	579	900			
1911	558	558	Totals	66,533	$526,629

*Productions for the year 1881-1886 (inc.) were reported as "tons of pig iron" (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

[a] Annual details concealed under 'Unapportioned.'

LEAD.

Bibliography: State Mineralogist Reports IV, VIII-XV (inc.), XVII-XXII (inc.).

Production of lead in California in 1925 increased approximately 40% in quantity and 60% in value over the preceding year. As in the past, the principal output was from lead-silver ores in Inyo County. The total recoverable lead in ores shipped from Californian mines in

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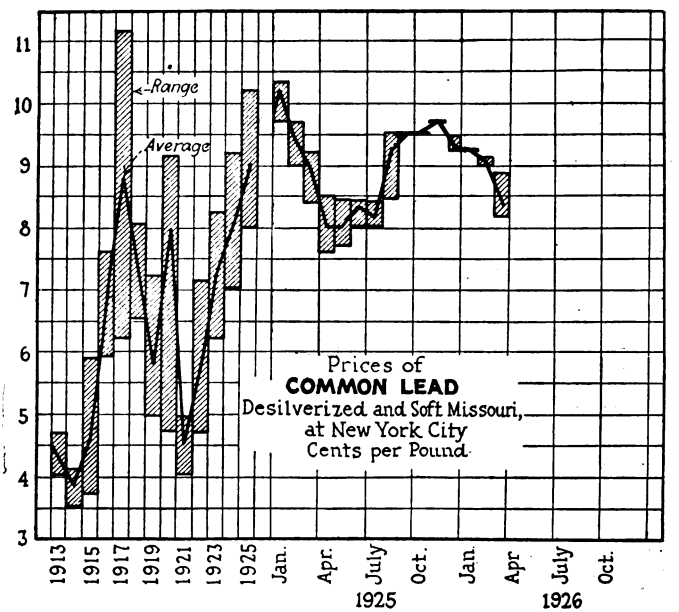
1925 amounted to 7,352,422 pounds valued at $639,661, compared with 4,984,387 pounds and $398,751 in 1924. This, in turn, however, was slightly less than the 1923 yield. The average price of lead in 1925 was 8.7¢ per pound as against 8.0¢ in 1924, 7.0¢ in 1923, and 3.9¢ in 1913.

The 1925 lead production was distributed by counties as follows:

Lead Production, by Counties, 1925.

County.	*Pounds.*	*Value.*
Inyo	6,301,105	$548,196
Mono	22,488	1,957
Riverside	135,872	11,821
San Bernardino	61,480	5,349
Shasta	647,886	56,366
Amador, Butte, Calaveras, Los Angeles, Nevada, Orange*	183,591	15,972
Totals	7,352,422	$639,661

*Combined to conceal output of a single operator in each.



From Engineering and Mining Journal-Press, April 3, 1926.

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Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Pounds	Value	Year	Pounds	Value
1887	1,160,000	$52,200	1908	1,124,483	$46,663
1888	900,000	38,250	1909	2,685,477	144,897
1889	940,000	35,720	1910	3,016,902	134,082
1890	800,000	36,000	1911	1,403,839	63,173
1891	1,140,000	49,020	1912	1,370,067	61,653
1892	1,360,000	54,400	1913	3,640,951	160,202
1893	666,000	24,975	1914	4,697,400	183,198
1894	950,000	28,500	1915	4,796,299	225,426
1895	1,592,400	49,364	1916	12,392,031	855,049
1896	1,293,500	38,805	1917	21,651,352	1,862,016
1897	596,000	20,264	1918	13,464,869	956,006
1898	655,000	23,907	1919	4,139,562	219,397
1899	721,000	30,642	1920	4,903,738	392,300
1900	1,040,000	41,600	1921	1,149,051	51,707
1901	720,500	28,820	1922	6,511,280	358,120
1902	349,440	12,230	1923	9,934,522	695,416
1903	110,000	3,960	1924	4,984,387	398,751
1904	124,000	5,270	1925	7,352,422.	639,661
1905	533,680	25,083			
1906	338,718	19,307	Totals	125,537,551	$8,082,724
1907	328,681	16,690			

MANGANESE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVIII. Bulletins 38, 67, 76, 91. U. S. G. S., Bull. 427. Eng. & Min. Jour.-Press, Vol. 117, p. 545.

Manganese ore shipments in California in 1925 amounted to a total of 732 tons of all grades valued at ~~$11,500~~, being a decrease both in quantity and value from the 1924 yield which totaled 1115 tons and $25,785 value. These ores showed analyses of from 45% to 55% Mn, and were utilized by Pacific Coast plants for ferromanganese.

Importations of foreign manganese ores in 1925, mainly from Brazil, amounted to a total of 291,662 long tons valued at $7,966,688, compared with 254,458 tons and $6,036,760 in 1924. The Tariff Act of 1922 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore or concentrates containing in excess of 30 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

Manganese Ore Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows California's output

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of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1907	1	$25
1888	1,500	13,500	1908	321	5,785
1889	53	901	1909	3	75
1890	386	3,176	1910	265	4,235
1891	705	3,830	1911	2	40
1892	300	3,000	1912	22	400
1893	270	4,050	1913		
1894	523	5,512	1914	150	1,500
1895	880	8,200	1915	4,013	49,098
1896	518	3,415	1916	18,404	274,601
1897	504	4,080	1917	15,515	396,659
1898	440	2,102	1918	26,075	979,235
1899	295	3,165	1919	11,569	451,422
1900	131	1,310	1920	2,892	62,323
1901	425	4,405	1921	1,005	12,210
1902	870	7,140	1922	540	7,650
1903	1	25	1923	690	10,620
1904	60	900	1924	1,115	25,785
1905			1925	532	11,500
1906	1	30	Totals	86,976	$2,370,904

MOLYBDENUM.

Bibliography: State Mineralogist Reports XIV, XVII. Bulletins 67, 91. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and -breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland, and Norway, with some also from Canada; but the United States is now able to supply its own requirements.

The growing consumption of molybdenum by alloy-steel makers in the United States has been stimulated by the fact that molybdenum alone of the steel-alloying metals can be produced commercially in the United States to an extent which avoids all necessity for importation. Another fact has been the marked adaptability of molybdenum steels to large-scale production of automobile and other parts.

The most important development of 1924-1925 was the elimination of ferromolybdenum from the market due to the substitution of calcium molybdate as the furnace addition by the entire alloy-steel industry. Calcium molybdate is stated to be not only easier and less costly to prepare, but it introduces the molybdenum into the steel bath

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in a much purer form, the resulting steel being superior to that made with ferromolybdenum.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war, 1916–1918. Some development work has been recently done on a high-grade deposit at the head of the Kaweah River, Tulare County.

Present quotations for molybdenum ore are 55¢ per pound for 85% MoS_2 concentrates.

Molybdenum Production of California, by Years.

California's production of molybdenum ore by years is summarized in the following tabulation:

Year	*Tons*	*Value*
1916	8	$9,945
1917	243	9,014
1918	*	300
Totals	251	$19,259

*300 pounds of 90% MoS_2 concentrate.

NICKEL.

Bibliography: State Mineralogist Reports XIV, XVII, U. S. G. S., Bulletin 640–D. U. S. Bureau of Standards, Circular 100.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work, but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are around 35¢–36¢ per pound for the refined metal.

OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII–XVIII. Bulletins 38, 45, 67, 85, 91, 92. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou, and Trinity.

The production of platinum-group metals in California for the year 1925 totaled 355 ounces, crude, containing 292 fine ounces, valued at $39,937. Of this amount, a total of 307 ounces, crude, or 86%, came from the gold dredges. This is a slight increase over the 273 fine ounces worth $36,452 sold in 1924.

The above-noted total of 292 fine ounces includes 120 fine ounces of iridium, osmiridium, ruthenium, and palladium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content.

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Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

For 1925, the distribution by counties of California's platinum yield was as follows:

Platinum Production, by Counties, 1925.

County	*Fine ounces*	*Value*
Butte	[a] 56	$9,177
Shasta	8	725
Trinity	26	3,081
Calaveras, Del Norte, Humboldt, Sacramento,[a] Siskiyou, Stanislaus, Yuba [b] *	202	26,954
Totals	292	$39,937

[a] Includes ruthenium and palladium.
[b] Includes palladium.
* Combined to conceal output of a single operator in each.

Uses, Markets, and Consumption.

Besides its well-known uses in jewelry, dentistry and for chemicalware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

According to Hill,[1] the total consumption of platinum metals in the United States in 1925 was 137,345 troy ounces, an increase over that consumed in 1924, distributed as follows:

"Platinum metals consumed in the United States as reported by refiners, 1924 and 1925, by industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1924						
Chemical	10,507	436	122	403	11,468	7
Electrical	16,588	3,099	1,269	.....	20,956	13
Dental	11,092	10,049	131	.....	21,272	13
Jewelry	87,151	12,480	2,204	746	102,581	62
Miscellaneous	5,012	2,122	634	973	8,741	5
Totals	130,350	28,186	4,360	2,122	165,018	100
1925						
Chemical	12,558	383	71	685	13,697	8
Electrical	18,845	3,157	1,579	111	23,692	13
Dental	9,293	14,952	95	.....	24,340	14
Jewelry	93,293	10,950	2,840	2,280	109,363	62
Miscellaneous	3,356	520	220	1,414	5,510	3
Totals	137,345	29,962	4,805	4,490	176,602	100

[1] Hill, J. M., Refined platinum and allied metals in 1925: U. S. Bur. of Mines, Press Bull., April 29, 1926.

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"Stocks.

"At the end of 1925 stocks of crude platinum metals in the hands of refiners were 79,093 ounces, an increase of 4554 ounces as compared with stocks on hand December 31, 1924.

"Stocks of platinum metals in hands of refiners in the United States December 31, 1921-1925, in troy ounces.

Year	Platinum	Palladium	Iridium	Others	Total
1921	38,514	21,042	4,991	3,113	67,660
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539
1925	44,024	26,740	3,720	4,609	79,093

Platinum Production of California, by Years.

The annual production and value since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1907	300	$6,255
1888	500	2,000	1908	706	13,414
1889	500	2,000	1909	416	10,400
1890	600	2,500	1910	337	8,386
1891	100	500	1911	511	14,873
1892	80	440	1912	603	19,731
1893	75	517	1913	368	17,738
1894	100	600	1914	463	14,816
1895	150	900	1915	667	21,149
1896	162	944	1916	886	42,642
1897	150	900	1917	619	43,719
1898	300	1,800	1918	571	42,788
1899	300	1,800	1919	*418	50,611
1900	400	2,500	1920	477	68,977
1901	250	3,200	1921	613	58,754
1902	39	468	1922	795	90,288
1903	70	1,052	1923	602	78,546
1904	123	1,849	1924	273	36,452
1905	200	3,320	1925	292	39,937
1906	91	1,647	Totals	14,192	$718,813

*Fine ounces, beginning with 1919.

QUICKSILVER.

Bibliography: State Mineralogist Reports IV, V, XII–XV, XVII–XXII (inc.). Bulletins 27, 78, 91. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96, 227; Bulletin 222.

Quicksilver was produced in California in seven counties during 1925 to the amount of 7683 flasks (of 75 pounds, avoirdupois) valued at $621,831, being a slight decrease in quantity but an increase in value compared with the 1924 output of 7948 flasks worth $543,080. This was due to improved prices. The average price received during 1925, according to the producers' reports to the State Mining Bureau, was $80.81 per flask, as against $68.33 in 1924 and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1925 was $82.60 per flask, the price ranging without sharp fluctuations between $79.90 and

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$82.83 from January 1st until the end of October. Beginning with November the quotations advanced sharply to $85.17 and to a maximum of $91.67, closing the year at $90.17. Thus far for 1926, San Francisco quotations have ranged between $88 and $90 per flask. The average of quotations for 1925 in New York was $83.13 per flask.

The above-noted yield of 7683 flasks in 1925 was won from a total of 59,797 tons of ore, being an average content of 9.64 pounds per ton, or 0.482% mercury.

The U. S. Bureau of Mines reports the total production of the United States for 1925 at 9174 flasks valued at $762,616 (using $83.128 as the average of New York quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Arizona, and Idaho. California's contribution was 84% of the total.

The imports of quicksilver in 1925 amounted to 11,245 flasks from Italy and 9754 flasks from Spain, and from all other countries 1782 flasks, making a total of 22,781 flasks. The exports were 204 flasks.

The 1925 quicksilver production in California was distributed, by counties, as follows:

County.	*Flasks.*	*Value.*
San Benito	6,085	$486,797
Sonoma	351	29,134
Kings, Monterey, Napa, San Luis Obispo, Santa Clara*	1,247	105,900
Totals	7,683	$621,831

*Combined to conceal output of a single operator in each.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs.

Gould [1] states:

"Consumption of the metal in this country continues to increase, principally in the electrical and allied industries. Although accurate data are not available, the United States will probably consume nearly 45,000 flasks of mercury in 1926, or about one-half of the world's production. This is twice the pre-war consumption, and each year shows a heavy increase. European advices indicate an increased demand for the metal on the continent, especially in Germany. For ten years prior to 1914, Germany was the world's largest market for quicksilver, and that country will probably again become a large consumer."

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, is shown in the following tabulation. Though the New Almaden Mine in Santa Clara County was first worked in 1924, and has been in practically continuous operation since 1846 (the yield being small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In

[1] Gould, H. W., Quicksilver: Eng. and Min. Jour-Press, Vol. 121, p. 91, Jan. 16, 1926.

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compiling this table the following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1889	26,464	$1,190,880	$45 00
1851	27,779	1,859,248	66 93	1890	22,926	1,203,615	52 50
1852	20,000	1,166,600	58 33	1891	22,904	1,036,406	45 25
1853	22,284	1,235,648	55 45	1892	27,993	1,139,595	40 71
1854	30,004	1,663,722	55 45	1893	30,164	1,108,527	36 75
1855	33,000	1,767,150	53 55	1894	30,416	934,000	30 70
1856	30,000	1,549,500	51 65	1895	36,104	1,337,131	37 04
1857	28,204	1,374,381	48 73	1896	30,765	1,075,449	34 96
1858	31,000	1,482,730	47 83	1897	26,691	993,445	37 28
1859	13,000	820,690	63 13	1898	31,092	1,188,626	38 23
1860	10,000	535,500	53 55	1899	29,454	1,405,045	47 70
1861	35,000	1,471,750	42 05	1900	26,317	1,182,786	44 94
1862	42,000	1,526,700	36 35	1901	26,720	1,285,014	48 46
1863	40,531	1,705,544	42 08	1902	29,552	1,276,524	43 20
1864	47,489	2,179,745	45 90	1903	32,094	1,335,954	42 25
1865	53,000	2,432,700	45 90	1904	*28,876	1,086,323	37 62
1866	46,550	2,473,202	53 13	1905	24,655	886,081	35 94
1867	47,000	2,157,300	45 90	1906	19,516	712,334	36 50
1868	47,728	2,190,715	45 90	1907	17,379	663,178	38 16
1869	33,811	1,551,925	45 90	1908	18,039	763,520	42 33
1870	30,077	1,725,818	57 38	1909	16,217	773,788	47 71
1871	31,686	1,999,387	63 10	1910	17,665	799,002	45 23
1872	31,621	2,084,773	65 93	1911	19,109	879,205	46 01
1873	27,642	2,220,482	80 33	1912	20,600	866,024	42 04
1874	27,756	2,919,376	105 18	1913	15,661	630,042	40 23
1875	50,250	4,228,538	84 15	1914	11,373	557,846	49 05
1876	75,074	3,303,256	44 00	1915	14,199	1,157,449	81 52
1877	79,396	2,961,471	37 30	1916	21,427	2,003,425	93 50
1878	63,880	2,101,652	32 90	1917	24,382	2,396,466	98 29
1879	73,684	2,194,674	29 85	1918	22,621	2,579,472	114 03
1880	59,926	1,857,706	31 00	1919	15,200	1,353,381	89 04
1881	60,851	1,815,185	29 83	1920	10,278	775,527	75 45
1882	52,732	1,488,624	28 23	1921	3,157	140,666	44 56
1883	46,725	1,343,344	28 75	1922	3,466	191,851	55 35
1884	31,913	973,347	30 50	1923	5,458	332,851	60 98
1885	32,073	986,245	30 75	1924	7,948	543,080	68 33
1886	29,981	1,064,326	35 50	1925	7,683	621,831	80 81
1887	33,760	1,430,749	42 38				
1888	33,250	1,413,125	42 50	Totals	2,213,539	$108,531,119	

*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII–XXII (inc.). Bulletins 67, 91. Min. & Sci. Press, March 1, 1919.

Except for the early-day production from the silver mines of the Calico district and the more recent production from those of the Randsburg area, both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper, lead, zinc, and gold ores.

The 1925 silver output of California totaled 3,054,416 fine ounces, valued at $2,106,871 compared with 3,555,153 fine ounces valued at

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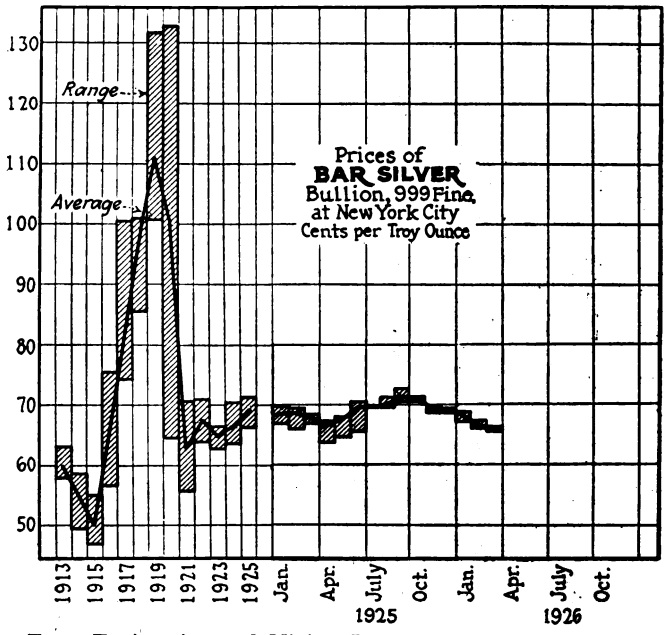
$2,381,952 in 1924. Of the 1925 yield, $12,894 was from placers. The average price of domestic silver during 1925 was 69.4¢ per ounce in New York, as against 67¢ in 1925, and $1.00 in 1921–1923 under the Pittman Act. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under Gold).



From Engineering and Mining Journal-Press, April 3, 1926.

The distribution of the 1925 silver yield, by counties, was as follows:

Silver Production, by Counties, 1925.

County.	*Fine ounces.*	*Value.*	*County.*	*Fine ounces.*	*Value.*
Alpine	2	$1	Nevada	46,333	32,155
Amador	23,232	16,123	Orange	1,433	995
Butte	6,274	4,354	Placer	893	620
Calaveras	11,994	8,324	Plumas	423,997	294,254
Del Norte	2	1	Riverside	3,703	2,570
El Dorado	343	238	Sacramento	2,767	1,920
Fresno	217	151	San Bernardino	1,986,155	1,378,392
Humboldt	90	62	San Diego	83	58
Inyo	169,688	117,763	San Luis Obispo	10	7
Kern	10,742	7,455	Shasta	300,890	208,818
Lassen	34	24	Sierra	12,852	8,919
Los Angeles	22,254	15,444	Siskiyou	1,198	831
Madera	118	82	Stanislaus	1,000	694
Mariposa	2,533	1,758	Trinity	11,129	7,724
Merced	2	1	Tuolumne	885	614
Mono	2,291	1,590	Yuba	9,222	6,400
Monterey	4	3			
Napa	2,046	1,420	Totals	3,054,416	$2,119,765

The following paragraphs are quoted from the U. S. Bureau of Mines, Department of Commerce, Advance Chapter on Gold and Silver for 1925, by courtesy of Mr. J. M. Hill, statistician in charge of the San Francisco branch office:

"The production of silver in 1925 was 3,054,416 ounces, valued at $2,119,765, a decrease of 14 per cent in quantity and 11 per cent in value as compared with 1924. Four counties produced over 100,000 ounces of silver in 1925, namely, San Bernardino with 1,986,155 ounces largely from silver ore produced by the California Rand

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Silver (Inc.), Plumas County with 423,997 ounces largely produced from copper ores of the Engels and Walker mines, Shasta County with 300,890 ounces largely from copper and zinc ores, and Inyo County with 169,688 ounces, most of which was from lead ores. The next largest silver production was 46,333 ounces from Nevada County gold ores, followed by 23,232 ounces from Amador County gold ores.

"The yield of silver from placer mines in 1925 was 18,579 ounces, an increase of 11 per cent as compared with 1924 and 0.61 per cent of the total silver output of the State. Of the 3,035,837 ounces of silver produced at deep mines in 1925, silver ore and tailings yielded 66 per cent, copper ore and tailings 23 per cent, lead ore 6 per cent, zinc ore and lead-zinc ore each 1 per cent, and gold ore and tailings 3 per cent. There were decreases in production of silver in all the more important silver-producing counties except Plumas, which increased its production of silver by 54,491 ounces. San Bernardino County produced 299,812 ounces less, Shasta County 211,651 ounces less, and Inyo County 3,146 ounces less silver than in 1924.

"Silver production at 45 properties was in excess of 1,000 ounces in 1925 and these mines yielded 98 per cent of the total silver produced in the State. At 30 properties the yield was between 1,000 and 10,000 ounces, at 11 between 10,000 and 60,000, at 3 between 100,000 and 300,000, and at 1 mine in excess of 1,000,000 ounces in 1925. The 10 largest silver producers in 1925, in order of output, were the California Rand Silver (Inc.), U. S. Smelting, Refining & Mining Co. (Mammoth mines), Walker Mining Co., Engels Copper Mining Co., Tecopa Consolidated Mining Co., Shorey Tailings Plant, Mulcahy Bros., Cerro Gordo Mines Co., California Zinc Co., and the Empire Mines Co."

Silver Production of California, by Years.

The amount and value of the silver production of California, and the average price, annually, since 1880 are given in the table following. In the table shown in the statistical bulletins previous to this present Bulletin 97 (for 1925), the values shown for 1880-1904 (inc.) were taken from the reports of the Director of the Mint, of which the figures for 1880-1896 (inc.) were based on 'coinage value' ($1.2929 per fine ounce). We have recalculated these to commercial value, using the price table of the U. S. Geological Survey (McCaskey, H. D., Gold and Silver, 1913: Mineral Resources of the U. S., Part I, p. 847). From 1905 to date, the figures are those of the U. S. Geological Survey and its successor, the U. S. Bureau of Mines.

Year	Fine oz.	Value	Average price per oz.	Year	Fine oz.	Value	Average price per oz.
1880	882,169	$1,014,494	$1 15	1904	1,441,259	$835,929	58
1881	580,091	655,503	1 13	1905	1,076,174	650,009	61
1882	653,569	745,069	1 14	1906	1,220,641	817,830	68
1883	1,129,244	1,253,461	1 11	1907	1,138,856	751,646	66
1884	3,236,987	3,593,056	1 11	1908	1,647,278	873,057	53
1885	1,986,260	2,125,298	1 07	1909	2,098,253	1,091,092	52
1886	1,245,747	1,233,290	0 99	1910	1,840,085	993,646	54
1887	1,262,282	1,237,036	0 98	1911	1,270,445	673,336	53
1888	1,314,874	1,235,982	0 94	1912	1,300,136	799,584	615
1889	823,947	774,510	0 94	1913	1,378,399	832,553	604
1890	820,336	861,353	1 05	1914	1,471,859	813,938	553
1891	737,224	729,852	0 99	1915	1,678,756	851,129	507
1892	358,575	311,960	87	1916	2,564,354	1,687,345	658
1893	415,468	324,065	78	1917	1,775,431	1,462,955	824
1894	229,896	144,834	63	1918	1,427,711	1,427,711	1 00
1895	463,911	301,542	65	1919	1,107,189	1,240,051	1 12
1896	326,757	222,195	68	1920	1,706,327	1,859,896	1 09
1897	754,648	452,789	60	1921	3,629,223	3,629,223	1 00
1898	701,788	414,055	59	1922	3,100,065	3,100,065	1 00
1899	855,869	513,521	60	1923	3,559,443	2,918,743	82
1900	1,168,157	724,257	62	1924	3,555,133	2,381,952	67
1901	950,831	570,499	60	1925	3,054,416	2,119,765	694
1902	1,163,041	616,412	53				
1903	958,230	517,444	54	Totals	66,061,334	$52,383,932	

TIN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 67, 91.

Tin is not at present produced in California; but during 1891–1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

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Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets have been taken out.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies), followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Wales, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by detinning scrap and old cans. A recent press bulletin (July 23, 1926) of the U. S. Bureau of Mines states that more than 1000 long tons of old tin cans were detinned in 1925, yielding a recovery of nearly 25 pounds of tin per ton of cans.

Total Output of Tin in California.

Year	Pounds	Value
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 38, 67, 91, 95. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc. Vol. XI. South Dakota School of Mines, Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and has now practically regained its pre-war average annual tonnage, though the 1925 figures are about 25 per cent less than those for 1924.

The material shipped in 1925 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties. A total of 8619 tons of all grades was reported produced, and in part concentrated, yielding 573 tons recalculated to 60% WO_3, valued at a total of $348,471.

Prices during 1925 ranged rather regularly from $9 per unit, duty paid, for Chinese wolframite in January, to $12 in December; with domestic scheelite commanding 50¢ to $1 per unit higher. Present (May, 1926) prices are $11.75 to $12.75 with domestic demand light, though curtailment of Chinese supplies is anticipated.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output has in some years equaled or exceeded that of

[1] U. S. G. S., Bull. 652, p. 32.

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ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent.

Imports of foreign tungsten ore and alloys into the United States during 1925 amounted to 3,089,589 pounds, valued at $735,108, compared with 79,595 pounds valued at $24,981 in 1924, and 10,362 long tons of ore valued at $11,409,237 in 1918, which ores were duty free up to September 22, 1922. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and the low market prices, practically all of the tungsten mines in the United States were closed down from the middle of 1919 to the latter part of 1923. Quotations during 1922 ranged around $2.50 per unit, up to September. The Tariff Act of 1922 placed a duty on tungsten ore or concentrates of 45¢ per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys.

Uses.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included. Tungsten compounds are used in the manufacture of colors.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3267° C. (5913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Total Tungsten Ore Production of California.

The annual amount and value of tungsten ores and concentrates produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	1916	2,270	$4,571,521
1906	485	189,100	1917	2,466	3,079,013
1907	287	120,587	1918	1,982	2,832,222
1908	105	37,750	1919	214	219,316
1909	577	190,500	1920		
1910	457	208,245	1923	34	19,126
1911	387	127,706	1924	781	446,009
1912	572	206,000	1925	573	348,475
1913	559	234,673			
1914	420	180,575	Totals	13,188	$14,035,081
1915	962	1,005,467			

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VANADIUM.

Bibliography: Report XV. Bulletins 67, 91. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Some ore carrying lead vanadate has been developed in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties, but no shipments reported.

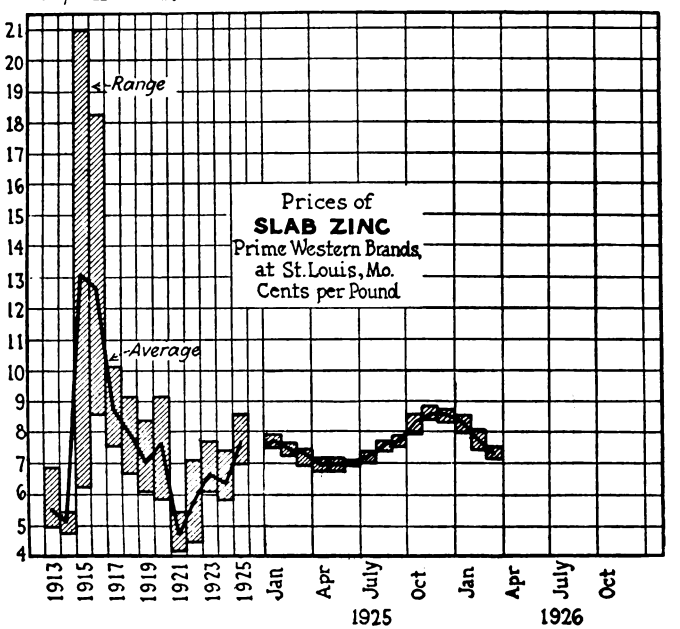
The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present New York quotations for vanadium ore are @ 60¢–65¢ per pound of contained V_2O_5 (carrying 12%–18% V_2O_5).

ZINC.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XX, XXII. Bulletins 38, 67, 91.

Recoverable zinc in ores mined in California in 1925 amounted to 11,546,602 pounds valued at $877,542, compared with 3,060,000 pounds and $198,900 in 1924. The 1924 output was marketed entirely in the form of the oxide; but the major portion of the 1925 yield (in the form of concentrates) was shipped to Belgium for treatment. A small amount of oxide was marketed.

The average price per pound quoted for the metal in 1925 was 7.6¢ as against 6.5¢ in 1924.



From Engineering and Mining Journal-Press, April 3, 1926.

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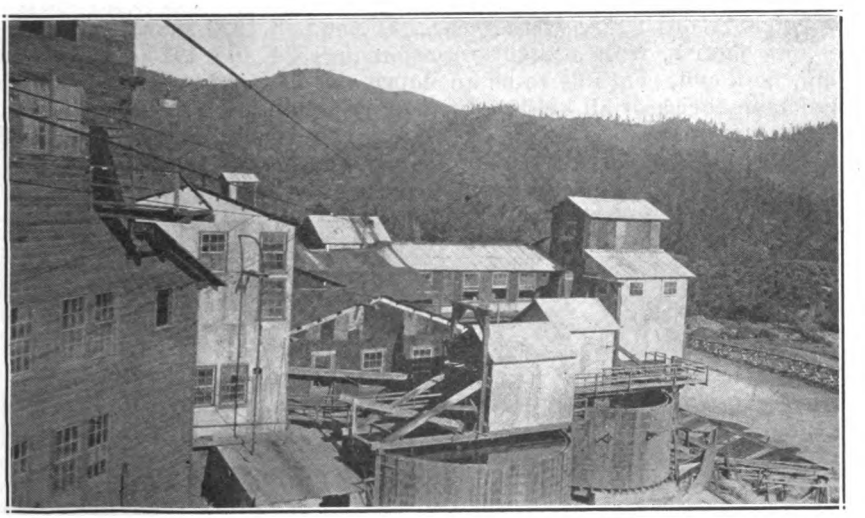
The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20% a large portion is rolled into plates and sheets, and utilized in the building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1917	11,854,804	$1,209,190
1907	177,759	10,598	1918	5,565,561	506,466
1908	54,000	3,544	1919	1,384,192	101,046
1909			1920	1,188,009	96,229
1910			1921	846,184	42,309
1911	2,679,842	152,751	1922	3,034,430	172,963
1912	4,331,391	298,866	1923		
1913	1,157,947	64,845	1924	3,060,000	198,900
1914	399,641	20,381	1925	11,546,602	877,542
1915	13,043,411	1,617,383			
1916	15,950,565	2,137,375	Totals	76,480,338	$7,522,954



Concentrating plant of California Zinc Company at Winthrop, Shasta County.
Photo by C. A. Logan.

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CHAPTER FOUR.

STRUCTURAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXII (inc.). Bulletin 38. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1925 was valued at $53,526,995 as compared with a total value of $51,310,197 for the year 1924, the increase being due mainly to cement and granite.

Deposits of granite, marble and other building stones are distributed widely throughout this state, and transportation and other facilities are gradually being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though from 1914 to 1918 there was a falling off common to all building materials. The 1925 output establishes a new high-level mark, in quantity, but the total value was a little short of the record figure of 1923.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, and in 1923 showed advances to new figures, with a slight recession in 1924 and 1925. This item will, no doubt, continue to be an improtant one, and a market for fire and fancy brick of all kinds will unquestionably never be lacking.

All fifty-eight counties contributed to this structural total for 1925. There is not a county in the state which is not capable of some output of at least one of the materials under this classification.

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The following summary shows the value of the structural materials produced in California during the years 1924–1925, with increases or decreases in each instance:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	6,040 tons	$14,922	*	*	* —
Brick and hollow building tile		9,137,908		$7,503,976	$1,633,932—
Cement	11,655,131 bbls.	23,225,850	13,206,630 bbls.	25,043,335	1,817,485+
Chromite	350 tons	6,700	591 tons	10,912	4,212+
Granite		1,211,046		1,853,859	642,813+
Lime	62,029 tons	703,355	61,922 tons	685,528	17,827—
Magnesite	67,236 tons	900,183	64,623 tons	872,944	27,239—
Marble	[a]61,579 cu. ft.	140,253	35,664 cu. ft.	116,105	24,148—
Onyx and travertine	[b]		19,940 cu. ft.	16,120	16,120+
Sandstone	6,700 cu. ft.	3,600	14,704 cu. ft.	14,362	10,762+
Stone, miscellaneous		15,966,380		17,409,854	1,443,474+
Total value		$51,310,197		$53,526,995	
Net increase					$2,216,798+

*Under 'Unapportioned.'
[a] Includes onyx and travertine.
[b] Combined with marble.

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII–XV (inc.), XVII, XVIII. Bulletins 16, 32, 63, 67, 69, 91.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XXI, XXII.

Small amounts of bituminous rock are still occasionally used for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost eliminated the direct use of the native material. As there was only a single operator in 1925, the figures are concealed under the 'Unapportioned' item.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent probably the residue from the evaporation of a crude petroleum deposit.

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Bituminous Rock Production of California, by Years.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1908	30,718	$109,818
1888	50,000	257,000	1909	34,123	116,436
1889	40,000	170,000	1910	87,547	165,711
1890	40,000	170,000	1911	75,125	117,279
1891	39,962	154,164	1912	44,073	87,467
1892	24,000	72,000	1913	37,541	78,479
1893	32,000	192,036	1914	66,119	166,618
1894	31,214	115,193	1915	17,789	61,468
1895	38,921	121,586	1916	19,449	66,561
1896	49,456	122,500	1917	5,590	18,580
1897	45,470	128,173	1918	2,561	9,067
1898	46,836	137,575	1919	4,614	18,537
1899	40,321	116,097	1920	5,450	27,825
1900	25,306	71,495	1921	8,298	43,192
1901	24,052	66,354	1922	4,624	13,570
1902	33,490	43,411	1923	2,945	11,780
1903	21,944	53,106	1924	6,040	14,922
1904	45,280	175,680	1925	*	*
1905	24,753	60,436			
1906	16,077	45,204	Totals	1,181,810	$3,632,155
1907	24,122	72,835			

*Concealed under 'Unapportioned.'

BRICK and HOLLOW TILE.

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII–XXII (inc.). Bulletin 38. Preliminary Report, No. 7. Cal. Jour. of Development, June, 1925, pp. 5–6.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diversified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain products are shipped over a much wider radius. So far as possible, the different kinds have been segregated in the tabulation herewith accompanying.

We also include under this heading the various forms of hollow building 'tile' or blocks. The application of these tile to residence construction as well as to other structures is growing; though their total for 1925 shows a slight drop from the figure of 1924.

The aggregate value of all kinds of brick in 1925 shows a decrease of approximately 18% from that of 1924, due mainly to a drop in the sales of common brick in the Los Angeles district. The total of glazed, pressed, fancy, vitrified, paving, and sand-lime brick also showed a decrease; while fire-brick advanced.

The detailed figures of brick and hollow tile production for 1925 by counties are given in the following tabulation. 'Production' in this case means *sales* of product of California manufacture; and 'value' is *net price* at the works, f. o. b. cars, trucks or boats.

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Brick and Hollow Tile Production for 1925, by Counties.

County	Common		Fire		Glazed, pressed, fancy, vitrified, paving		Hollow building tile or blocks		Total value
	Amount, M	Value	Amount, M	Value	Amount, M	Value	Tons	Value	
Alameda	*		3,105	$169,695	4,788	$213,057	*		$382,752
Fresno	6,048	$86,174	*		*		*		86,174
Kern	5,798	67,773							67,773
Los Angeles	170,771	1,754,639	[a]6,615	592,957	[b]19,569	953,152	44,845	$426,178	3,726,926
Orange	3,238	38,890			*				38,890
Sacramento	17,233	253,589	90	3,368	*		*		256,957
San Diego	7,981	93,165			*		*		93,165
San Joaquin	8,087	105,723	*				*		105,723
Santa Barbara	4,205	56,781					1,864	18,706	75,487
Santa Clara	24,250	251,059							251,059
Alameda, Amador, Butte, Contra Costa, Humboldt, Imperial, Marin, Mendocino, Merced, Riverside, San Luis Obispo, Tehama, Tulare*	49,838	609,973							609,973
Amador, Contra Costa, Fresno, Merced, Placer[c], Riverside, San Joaquin*			18,391	884,486					884,486
Contra Costa, Fresno, Merced, Orange, Placer, Riverside, Sacramento, San Diego, San Luis Obispo*					11,087	347,905			347,905
Alameda, Contra Costa, Fresno, Merced, Placer, Riverside, Sacramento, San Diego, San Joaquin*							58,782	576,706	576,706
Totals	297,449	$3,317,766	28,201	$1,650,506	35,444	$1,514,114	105,491	$1,021,590	$7,503,976

*Combined to conceal output of a single operator in each.
[a] Includes special silica brick.
[b] Includes Ferguson sewer liners.
[c] Includes fire tile.

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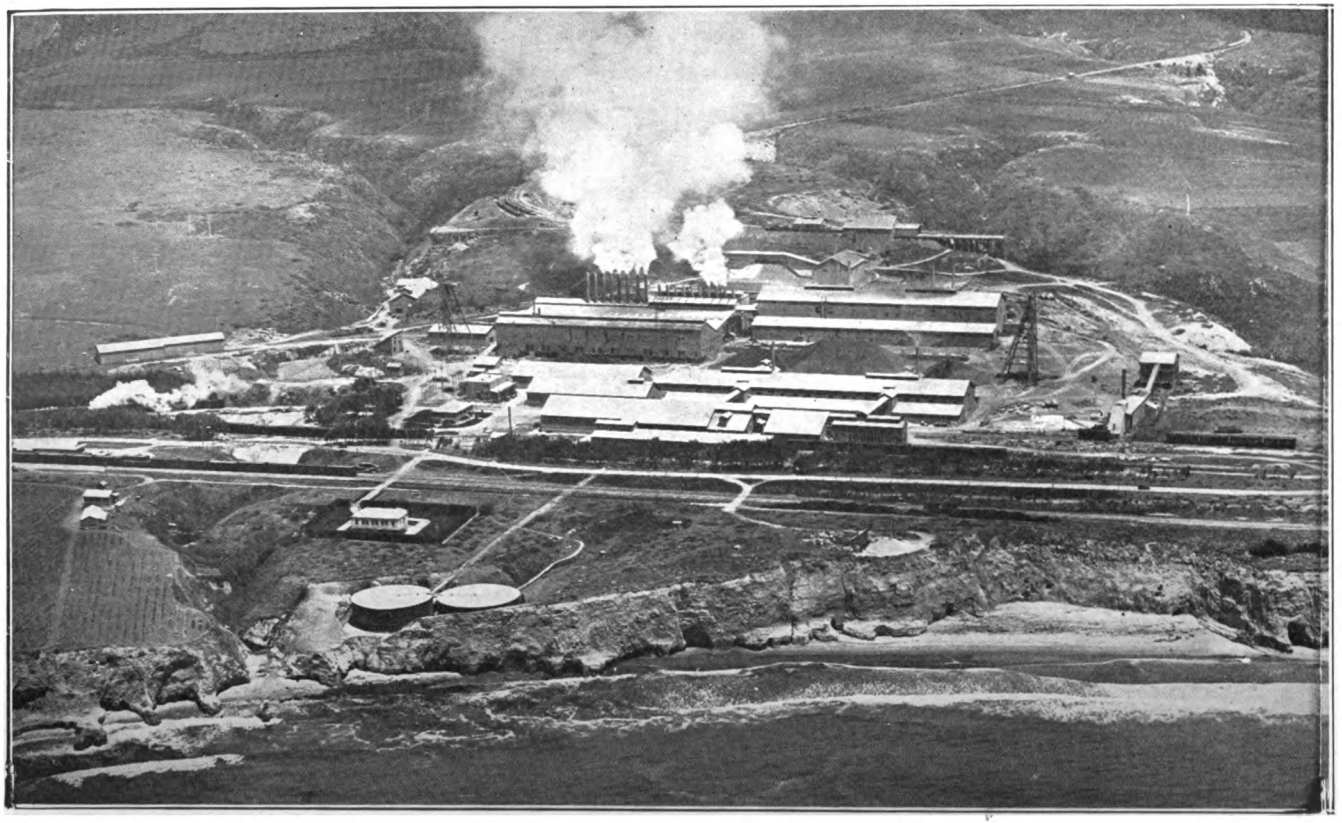

Plant of Santa Cruz Portland Cement Company, Davenport, Santa Cruz County. Airplane photo by courtesy of the company.

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Brick and Hollow Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for hollow building 'tile' or blocks being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Brick, M	Hollow building blocks, tons	Value
1893	103,900		$801,750
1894	81,675		457,125
1895	131,772		672,360
1896	24,000		524,740
1897	97,468		563,240
1898	100,102		571,362
1899	125,950		754,730
1900	137,191		905,210
1901	130,766		860,488
1902	169,851		1,306,215
1903	214,403		1,999,546
1904	281,750		1,994,740
1905	286,618		2,273,786
1906	277,762		2,538,848
1907	362,167		3,438,951
1908	332,872		2,506,495
1909	333,846		3,059,929
1910	340,883		2,934,731
1911	327,474		2,638,121
1912	337,233		2,940,290
1913	358,754		2,915,350
1914	270,791		2,288,227
1915	180,538		1,678,756
1916	206,960		2,096,570
1917	192,269	29,348	2,532,721
1918	136,374	34,818	2,363,481
1919	156,328	36,026	3,087,067
1920	245,842	99,208	5,704,393
1921	238,022	67,100	5,570,875
1922	374,853	105,909	7,994,991
1923	397,754	122,534	9,738,082
1924	456,716	114,469	9,137,908
1925	361,094	105,491	7,503,976
Totals	7,773,978	714,903	$96,355,054

CEMENT.

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII, XVIII, XXI, XXII, Bulletin 38.

Cement is the most important single structural material in the mineral output of this state. During 1925, there was produced a total of 13,206,630 barrels, valued at $25,043,335 f. o. b. plant. This is an increase of 1,551,499 barrels over the record figure of 11,655,131 barrels in 1924, and an increase of $1,817,530 over the 1924 value of $23,225,850, but still a little short of the record value of $25,999,203 in 1923. The market in 1925 recovered to some extent from the effect of foreign importations duty-free, which caused the drop in 1924, but the effect had not wholly disappeared.

The 1925 output came from ten operating plants in eight counties, and employing a total of 3166 men. The three plants in San Bernardino County made a total of 5,079,281 barrels valued at $8,828,044, the

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balance of the state's product coming from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, San Mateo, Santa Cruz, and Solano. The new plant of the Pacific Portland Cement Company at Redwood City, San Mateo County, began commercial production in 1925. For 1926, the plant of the Calaveras Cement Company has been completed near San Andreas, Calaveras County, and has joined the producing list.

Cement Production of California, by Years.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

[1] "The Benicia Cement Company in 1859-60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12,000 barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield beginning with 1920 has since annually exceeded the value of her gold output.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1910	5,453,193	$7,485,715
1892	5,000	15,000	1911	6,371,369	9,085,625
1893			1912	6,198,634	6,074,661
1894	8,000	21,600	1913	6,167,806	7,743,024
1895	16,383	32,556	1914	5,109,218	6,558,148
1896	9,500	28,250	1915	4,918,275	6,044,950
1897	18,000	66,000	1916	5,299,507	6,210,293
1898	50,000	150,000	1917	5,790,734	7,544,282
1899	60,000	180,000	1918	4,772,921	7,969,909
1900	52,000	121,000	1919	4,645,289	8,591,990
1901	71,800	159,842	1920	6,709,160	14,962,945
1902	171,000	423,600	1921	7,404,221	18,072,120
1903	640,868	968,727	1922	8,962,135	16,524,056
1904	969,538	1,539,807	1923	10,825,405	25,999,203
1905	1,265,553	1,791,916	1924	11,655,131	23,225,850
1906	1,286,000	1,941,250	1925	13,206,630	25,043,335
1907	1,613,563	2,585,577			
1908	1,629,615	2,359,692	Totals	125,140,653	$214,505,350
1909	3,779,205	4,969,437			

CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII, XVIII, XXI, XXII. Bulletins 38, 76, 91. Preliminary Report 3. U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 191 short tons, recalculated to a basis of 45% Cr_2O_3, valued at $3,712 f.o.b. shipping

[1] Monthly Review, of Mercantile Trust Co. of Cal., Vol. XIII, No. 3, p. 55, Mar. 1924.

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point, was sold in California during the year 1925. This was largely of ore that had been mined during the World War period but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

With reference to the War Minerals Relief bills and their administration in which the chromite producers are particularly interested, under the Shortridge amendment of 1921 and under indirect or published stimulation as distinguished from direct personal demand, there has been paid to claimants principally in western states more than five million dollars; while under the act of March 2, 1919, which has been so construed as to limit recoveries to losses induced by direct personal demand, there has been paid about two million. Certain rejected losses now being litigated are principally in claims under the original act, though there are many claimants qualified under the Shortridge amendment who will be entitled to relief in the event the litigation is favorable to the claimants, or in the event further, pending legislation (Oddie's Senate Bill 3641) is enacted.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1820 to 1860 the deposits in Pennsylvania and Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proved to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons was shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promise well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production came from that source.

Imports.

Importations of foreign chromite, duty free, mainly from Rhodesia, New Caledonia, and India, totaled 149,739 long tons in 1925, valued at $1,207,420, compared with 118,343 long tons and $1,095,603 in 1924.

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Uses.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1874-1886 (San Luis Obispo Co.)	26,028	$329,924	1907	302	$6,040
1887	3,000	40,000	1908	350	6,195
1888	1,500	20,000	1909	436	5,309
1889	2,000	30,000	1910	749	9,707
1890	3,599	53,985	1911	935	14,197
1891	1,372	20,580	1912	1,270	11,260
1892	1,500	22,500	1913	1,180	12,700
1893	3,319	49,785	1914	1,517	9,434
1894	3,680	39,980	1915	3,725	38,044
1895	1,740	16,795	1916	48,943	717,244
1896	786	7,775	1917	52,379	1,130,298
1897	----------	----------	1918	73,955	3,649,497
1898	----------	----------	1919	*4,314	97,164
1899	----------	----------	1920	1,770	43,031
1900	140	1,400	1921	347	6,870
1901	130	1,950	1922	379	6,334
1902	315	4,725	1923	84	1,658
1903	150	2,250	1924	350	6,700
1904	123	1,845	1925	191	3,712
1905	40	600	Totals	242,915	$6,422,897
1906	317	2,859			

* Recalculated to 45% Cr_2O_3, beginning with 1919.

GRANITE.

Bibliography: State Mineralogist Reports, X, XII–XXI (inc.). Bulletin 38.

The value of the granite output of California for 1925 was the highest recorded for any year since the compilation of these figures by the State Mining Bureau, due mainly to the contract for the construction of the new Los Angeles County Building. Stone for 'monumental' and decorative purposes showed a decrease in both quantity and total value. The net result was an increase in total value of the several groups from $1,211,046 to $1,853,859. We have included under this heading some rhyolite and tuff utilized for dimension building stone, as we have no other dimension stone grouping for statistical purposes in this report except marble and sandstone.

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Crushed rock, rubble, and paving blocks derived from granite quarries are given under the heading of 'Miscellaneous Stone.'

So far as possible, granite production has been segregated in the table herewith into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'Unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

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Granite Production by Counties, for 1925.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			15,097	$63,580					$63,580
Placer	*		3,513	6,426	*		*		6,426
Riverside	335	$900	6,000	28,502			1,150	$2,832	32,234
Sacramento	124,200	155,250							155,250
San Diego	50	125	28,456	108,578					108,703
Inyo[a], Madera, Placer, Sonoma[a], Tulare*	46,704	118,127							118,127
Madera, Nevada, Plumas, Tulare, Tuolumne*			5,604	24,392					24,392
Madera, Nevada, Placer*					3,181	$4,103			4,103
Madera, Placer, Tulare*							674,079	1,341,044	1,341,044
Totals	171,289	$274,402	58,670	$231,478	3,181	$4,103	675,229	$1,343,876	$1,853,859

* Combined to conceal output of a single operator in each.
[a] Tuff used for building stone.

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Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1907	$373,376
1888	57,000	1908	512,923
1889	1,329,018	1909	376,834
1890	1,200,000	1910	417,898
1891	1,300,000	1911	355,742
1892	1,000,000	1912	362,975
1893	531,322	1913	981,277
1894	228,816	1914	628,786
1895	224,329	1915	227,928
1896	201,001	1916	535,339
1897	188,024	1917	221,997
1898	147,732	1918	139,861
1899	141,070	1919	220,743
1900	295,772	1920	495,732
1901	519,285	1921	725,901
1902	255,239	1922	676,643
1903	678,670	1923	760,081
1904	467,472	1924	1,211,046
1905	353,837	1925	1,853,859
1906	344,083	Total value	$20,691,614

LIME.

Bibliography: Reports XIV, XV, XVII, XVIII. Bulletin 38.

Lime to the amount of 61,922 tons, valued at $685,528, was produced by nine plants in seven counties during 1925, as compared with 62,922 tons valued at $703,355, in 1924. There were two plants each in San Bernardino and Santa Cruz counties, and one each in El Dorado, Kern, Siskiyou, Tulare, and Tuolumne.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

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Lime Production of California, by Years.

The following tabulation gives the amounts and value of lime produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. The figures for quantity have been recalculated from 'barrels' to 'tons' for the years 1894-1922 (inc.):

Year	Tons	Value	Year	Tons	Value
1894	37,350	$318,700	1911	42,959	$390,988
1895	39,776	386,094	1912	52,212	464,440
1896	30,275	261,505	1913	61,344	528,547
1897	28,780	252,900	1914	43,996	378,663
1898	29,786	254,010	1915	35,653	286,304
1899	29,985	314,575	1916	49,364	390,475
1900	31,252	283,699	1917	50,073	311,380
1901	31,738	334,688	1918	43,684	461,315
1902	44,866	369,616	1919	42,070	552,043
1903	49,659	418,280	1920	46,314	557,232
1904	57,945	571,749	1921	46,353	610,619
1905	61,700	555,322	1922	57,875	671,747
1906	68,927	763,060	1923	70,894	788,834
1907	68,422	756,376	1924	62,029	703,355
1908	39,639	379,243	1925	61,922	685,528
1909	52,075	577,824			
1910	47,951	477,683	Totals	1,516,868	$15,056,794

MAGNESITE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXII. Bulletins 38, 79. U. S. Geol. Surv., Bulletins 355, 540; Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17, and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444. Eng. & Min. Jour.-Press, Vol. 114, July 29, and Dec. 2, 1922. U. S. Tariff Comm., "Crude and Caustic Calcined Magnesite. A Preliminary Statement of Information," May 19, 1926.

The production of magnesite in California during 1925 amounted to a total of 64,623 tons of crude ore valued at $872,944. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 28,110 tons shipped calcined, of which 3726 tons was dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1925 output is a slight decrease both in quantity and value from the 1924 figures of 67,236 tons crude valued at $900,193. The average of the values reported for 1925 is $13.50 per ton compared with $13.40 in 1924.

The more important producing properties in 1925 were: Maltby No. 1 (Western Magnesite Development Co., operated under lease by C. S. Maltby) on Red Mountain, Santa Clara County; and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order by the Sampson Peak Mine (Maltby No. 3), San Benito County and California Magnesia Company (old Harker Mine) at Porterville. A small amount was also contributed from Stanislaus County.

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A preliminary press bulletin by Mr. J. M. Hill of the U. S. Bureau of Mines (Mar. 1, 1926) shows: Imports of magnesite in 1925 were 4429 tons crude, valued at $54,593, most of which came from Italy; 17,102 tons of caustic calcined, valued at $414,734, over half of which came from India, and 47,613 tons of dead-burned, valued at $703,074, practically all of which was from Italy. This was the equivalent of a total of 143,440 tons of crude ore.

Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide) and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2 as calcite has but 44%.

Most of the California magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; but the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and Sierra Nevada Mountains, being associated with serpentine areas. The notable exceptions are the sedimentary deposits, at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomitic limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, recent experience has proved that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces. This is particularly true of the Refractory Magnesite Company's mine near Preston in Sonoma County, the White Rock Mine at Pope Valley and the Blanco Mine in Chiles Valley, Napa County. There is some also at the Sampson Peak property in San Benito County.

Uses.

The principal uses include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proved particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface. It has also a very strong bonding power, and will hold

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firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

For refractory purposes the calcined magnesite is largely made up into bricks similar to fire-brick for furnace linings. It is also used unconsolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows of a slight sintering in forming the brick. Dead-burned, pure magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Before the World War, practically all of the domestic output of caustic magnesite was used in the manufacture of pulp and paper. For this purpose calcined dolomite is now used. The use of dolomite instead of magnesite by paper manufacturers began during the war when the price of magnesite was very high. Dolomite was found to be a good substitute for magnesite in the bisulphite process of paper making and so its use has continued.

The following table, based upon a study by the U. S. Tariff Commission,[1] shows the amounts and percentages of caustic magnesite used for various purposes during the first nine months of 1923.

"Use	*Short ton*	*Per cent of total*
"Stucco	34,420	73.6
Flooring	5,953	12.8
Rubber trade	577	1.2
Insulation	796	1.5
Chemicals	3,192	6.9
Not determined	1,865	4.0
	46,803	100.0

"Later information received from the magnesite trade indicates that a somewhat larger proportion of both domestic and foreign magnesite is being used for stucco and a smaller proportion for flooring. The exact amounts are not known.

* * * * * * *

"Transportation.

"All domestic caustic magnesite originates in California, but most of it is consumed east of the Mississippi and north of the Ohio. The largest producer ships his lump calcined product by rail to Joliet, Illinois, or by the Panama Canal to Jersey City, to be ground. The costs of shipment by all rail or via Panama are about the same for destinations midway between Harrisburg and Pittsburgh, Pennsylvania.

* * * * * * *

"Area of Competition.

"The market distribution of domestic and foreign caustic magnesite in this country for the months of September, October, and November, 1923, and the same months of 1924, was the subject of a special study by the Tariff Commission. The geographic center of consumption for the domestic product was found to be about midway along the Ohio-Michigan border, and was moving south. The corresponding center for the foreign product was near Harrisburg, Pa., and was moving west. The center

[1] U. S. Tariff Comm.: Crude and Calcined Magnesite. A preliminary statement of Information, etc.: May 19, 1926, p. 4.

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for the combined domestic and foreign product was between Cleveland and Youngstown, Ohio, and was moving southwest.

* * * * * * *

"In the territory comprising the states of New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, and Virginia the tonnage of imported magnesite sold was greater and the average price less than of the domestic magnesite. In the states of Michigan, Ohio, Indiana, Kentucky, Illinois, Wisconsin, and Missouri, the tonnage of imported magnesite sold was less and the average price greater than of the domestic magnesite.

"Delivered Costs and Prices.

"Lump Magnesite. Foreign lump magnesite, all of which comes from British India, is entered at the port of New York. Approximately 17 per cent of the domestic production of magnesite comes in lump form to New York (Jersey City), via the Panama Canal, all shipments to Jersey City being made by one California producer.

"The lump of both foreign and domestic origin is ground and later sold as ground magnesite.

"Ground Magnesite. Imported lump is ground in Brooklyn, while domestic lump is ground in Jersey City, in California, and in Joliet, Illinois.

* * * * * * *

"Lump magnesite, both imported and domestic, after grinding in Brooklyn and Jersey City, competes with that ground before importation, and, as it moves west, comes into competition with that ground at Joliet and in California. The available data would indicate that the eastern limit of competition is the North Atlantic seaboard, and that the western limit is approximately the Mississippi River. For these reasons the transportation and grinding costs have been summarized, as shown in Table 15, for magnesite laid down in the vicinity of New York City, in Chicago, and in Cleveland, the approximate center of consumption of the competitive territory.

"The price of imported magnesite at the foreign plant and the cost of production of domestic magnesite cannot be shown since confidential information would be revealed thereby.

"Table 15. Comparative costs, 1924, of placing domestic and imported magnesite at selected points in the competitive territory.

"Cost of grinding is assumed to be uniform for all magnesite, domestic and imported, ground in the United States.

(Per short ton.)

East (New York and Jersey City).

Item	Domestic		Imported	
	Central California	*Southern California*	*India*	*Netherlands*
Transportation and other charges of lump magnesite to grinding plant	[1] $13 29	------	[1] $10 07	------
Assumed average grinding cost in the United States	[2] 6 00	------	[2] 6 00	[3] -----
Transportation and other charges of ground magnesite	------	------	------	[4] $7 80
Totals	$19 29	------	$16 07	[5] $7 80

Middle West (Chicago and Cleveland).

Transportation and other charges of lump magnesite to grinding plant	[6] $10 00	------	[1] $10 07	------
Assumed average grinding cost in the United States	6 00	$6 00	6 00	[3] ------
Subtotals	$16 00	$6 00	$16 07	------
Transportation of ground magnesite to Chicago	1 60	10 00	7 70	[7] $15 50
Totals at Chicago	$17 60	$16 00	$23 77	[5] $15 50
Transportation of ground magnesite to Cleveland	$4 10	$13 00	$5 10	[7] $12 90
Totals at Cleveland	$20 10	$19 00	$21 17	[5] $12 90

[1] Not including port charges at New York or Jersey City.
[2] Grinding done in metropolitan area of New York City.
[3] Grinding done in Netherlands; no cost data are available.
[4] Grinding plant in Netherlands, to New York; port charges at New York not included.
[5] Does not include cost of grinding in Netherlands.
[6] All rail to Joliet.
[7] Netherlands to Chicago or Cleveland; includes transportation, insurance, consul fees, and miscellaneous charges."

Imports and Domestic Production.

Reports of the U. S. Bureau of Foreign and Domestic Commerce show imports of calcined magnesite to have been 172,591 long tons in 1913; 144,747 in 1914, and 63,347 in 1915; most of it coming from

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Austria-Hungary and some from Greece, that from the former being refractory dead-burned and from the latter caustic. For the same years the production of crude (from 2 to 2½ tons of crude ore required to yield one ton of the calcined) magnesite in California (the sole producer of those years, in the United States) was: 9632 short tons, 11,438 tons, 30,721 tons, respectively. For 1916 the California output leaped to 154,052 tons of crude and to 209,648 tons in 1917, but following which it dropped considerably on account of resumption of foreign importations, which totaled 52,483 long tons in 1921, valued at $776,384, being then admitted duty free. Shipments from Washington were begun late in 1916; and during the following three years assumed important proportions.

The Tariff Act of 1922, which became effective September 22d, of that year, placed the following import duties on magnesite: Crude magnesite 5/16¢ per lb., caustic-calcined magnesite 5/8¢ per lb.; dead-burned and grain magnesite, not suitable for manufacture into oxychloride cements, 23/40¢ per lb.; magnesite brick, 3/4¢ per lb. and 10% ad valorem. The figures of imports for 1925 as published by the U. S. Bureau of Foreign and Domestic Commerce, show a total of 69,117 short tons of calcined ore valued at $1,172,644, as compared with 70,406 tons and $1,098,998 in 1924.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

Production of Magnesite in California, Since 1887.

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1907	6,405	$57,720
1888	600	9,000	1908	10,582	80,822
1889	600	9,000	1909	7,942	62,588
1890	600	9,000	1910	16,570	113,887
1891	1,500	15,000	1911	8,858	67,430
1892	1,500	15,000	1912	10,512	105,120
1893	1,093	10,930	1913	9,632	77,056
1894	1,440	10,240	1914	11,438	114,380
1895	2,200	17,000	1915	30,721	283,461
1896	1,500	11,000	1916	154,052	1,311,893
1897	1,143	13,671	1917	209,648	1,976,227
1898	1,263	19,075	1918	83,974	803,492
1899	1,280	18,480	1919	44,696	452,094
1900	2,252	19,333	1920	83,695	1,033,491
1901	4,726	43,057	1921	47,837	511,102
1902	2,830	20,655	1922	55,637	594,665
1903	1,361	20.515	1923	73,963	946,643
1904	2,850	9,298	1924	67,236	900,183
1905	3,933	16,221	1925	64,623	872,944
1906	4,032	40,320	Totals	1,035,324	$10,700,993

[1] See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

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MARBLE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXI (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 106.

Marble is widely distributed in California, and in a considerable variety of colors and grain. The 1925 figures show a slight decrease both in quantity and value from those of 1924, being 35,664 cu. ft., worth $116,105.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amounts were preserved.

Year	Cubic feet	Value	Year	Cubic feet	Value
1887	----------	$5,000	1907	37,512	$118,066
1888	----------	5,000	1908	18,653	47,665
1889	----------	87,030	1909	79,600	238,400
1890	----------	80,000	1910	18,960	50,200
1891	----------	100,000	1911	20,201	54,103
1892	----------	115,000	1912	27,820	74,120
1893	----------	10,000	1913	41,654	113,282
1894	38,441	98,326	1914	25,436	48,832
1895	14,864	56,566	1915	22,136	41,518
1896	7,889	32,415	1916	25,954	50,280
1897	4,102	7,280	1917	24,755	62,950
1898	8,050	23,594	1918	[a]17,428	49,898
1899	9,682	10,550	1919	25,020	74,482
1900	4,103	5,891	1920	[b]29,531	92,899
1901	2,945	4,630	1921	30,232	98,395
1902	19,305	37,616	1922	38,321	127,792
1903	84,624	97,354	1923	28,015	124,919
1904	55,401	94,208	1924	[b]61,579	140,253
1905	73,303	129,450	1925	35,664	116,105
1906	31,400	75,800	Total value	----------	$2,829,869

[a]Includes onyx and serpentine.
[b]Includes onyx.

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII, XVIII. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1925 there were shipments from Solano and Mono counties totaling 19,940 cu. ft., valued at $16,120. The Solano County material was mainly used for terrazzo.

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Onyx Production of California, by Years.

Production by years has been as follows:

Year	Value	Year	Value
1887	$900	1896	$24,000
1888	900	1918	*
1889	900	1919	
1890	1,500	1920	*
1891	2,400	1921	1,294
1892	1,800	1922	3,320
1893	27,000	1923	2,510
1894	20,000	1924	*
1895	12,000	1925	16,120
		Total value	$114,644

*See under Marble.

SANDSTONE.

Bibliography: State Mineralogist Reports XII–XV, XVII, XVIII, XXI. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1925 a total of 14,704 cu. ft. valued at $14,362 was quarried in four counties, Colusa, Los Angeles, Monterey, and Siskiyou; compared with 6,700 cu. ft. and $3,600 in 1924. The material reported from Monterey County is in reality an indurated shale of the Monterey series, of a cream-color and utilized as a building stone.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$175,000	1907	159,573	$148,148
1888		150,000	1908	93,301	55,151
1889		175,598	1909	79,240	37,032
1890		100,000	1910	165,971	80,443
1891		100,000	1911	255,313	127,314
1892		50,000	1912	66,487	22,574
1893		26,314	1913	62,227	27,870
1894		113,592	1914	111,691	45,322
1895		35,373	1915	63,350	8,438
1896		28,379	1916	17,270	10,271
1897		24,086	1917	31,090	7,074
1898		46,384	1918	900	400
1899	56,264	103,384	1919	5,400	3,720
1900	378,468	254,140	1920	10,500	2,300
1901	266,741	192,132	1921	10,150	2,112
1902	212,123	142,506	1922	900	1,100
1903	353,002	585,309	1923	7,000	13,000
1904	363,487	567,181	1924	6,700	3,600
1905	302,813	483,268	1925	14,704	14,362
1906	182,076	164,068	Total value		$4,126,945

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SERPENTINE.

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California, by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905		
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	a	a
1900	350	2,000	1918	b	b
1901	89	890	1919		
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[a] Under 'Unapportioned.'
[b] See under Marble.

SLATE.

Bibliography: State Mineralogist Reports XV, XVIII. Bulletin 38. U. S. Geol. Surv., Bull. 586. U. S. Bur. of Mines, Bull. 218.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

'Slate' is a term applied to a fine-grained rock that has a more or less perfect cleavage, permitting it to be readily split into thin, smooth sheets. Varieties differ widely in color and have a considerable range in chemical and mineralogical composition. Excepting certain rare slates of igneous origin (of which the green slate of the Eureka quarry, El Dorado County, California, is an example) formed from volcanic ash or igneous dikes, slates have originated from sedimentary deposits consisting largely of clay. By consolidation, and the pressure of superimposed materials, clays become bedded deposits of shale. By further consolidation under intense pressure and high temperature incident to mountain-building forces, shales are metamorphosed to slates. The principal mineral constituents are mica, quartz, and chlorite, with smaller varying amounts of hematite, rutile, kaolin, graphite, feldspar, tourmaline, calcite, and others.

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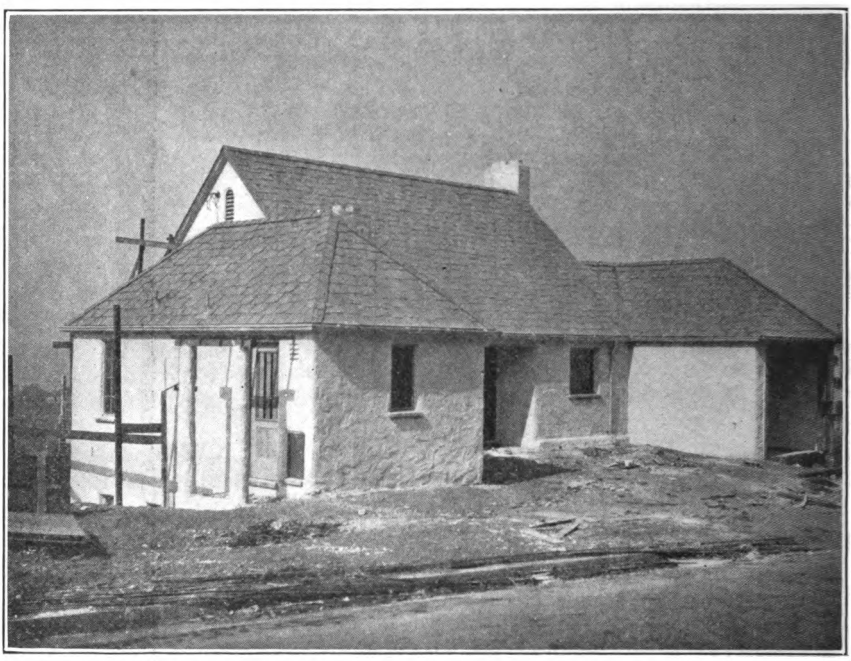
The color of slate is of economic importance. The common colors are gray, bluish gray, and black, though reds and various shades of green are occasionally found.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.

[1] "In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition."

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than



El Dorado County slate placed on roof of a residence being built in Oakland, California, September, 1926.

the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

In California, there were no shipments in 1925, but at present there are prospects of commercial output being renewed; in fact, some small shipments have already been made for the current year.

[1] Bowles, O., Slate as a permanent roofing material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

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Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1904	6,000	$50,000
1890	4,000	24,000	1905	4,000	40,000
1891	4,000	24,000	1906	10,000	100,000
1892	3,500	21,000	1907	7,000	60,000
1893	3,000	21,000	1908	6,000	60,000
1894	1,800	11,700	1909	6,961	45,660
1895	1,350	9,450	1910	1,000	8,000
1896	500	2,500	1911		
1897	400	2,800	1915	1,000	5,000
1898	400	2,800	1916		
1899	810	5,900	1920	8	80
1900	3,500	26,250	1921		
1901	5,100	38,250	1922	*	*
1902	4,000	30,000	1923		
1903	10,000	70,000	Totals	88,829	$676,479

*Concealed under 'Unapportioned.'

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII–XXII (inc.). Bulletin 38; also annual statistical bulletins from 1915 to date.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer; therefore it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. So far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put after they have quarried and sold the same to distributors and contractors.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept.

For the year 1925, crushed rock registered gains both in tonnage and value over the preceding year; as did also sand and gravel. The result was a total value of $17,409,854 as compared with $15,966,380 in 1924. Continuance of general building work and highway paving are in part responsible as well as hydro-electric power-plant installations and harbor protection (breakwater and jetty construction).

As for some years past, Los Angeles County led all others by a wide margin with an output valued at $6,978,605 (compared with $5,923,329); followed by Alameda, second, with $1,414,398; Contra Costa, third, $708,159; Humboldt, fourth, $699,740; Sacramento, fifth, $590,359; Riverside, sixth, $542,020; San Diego, seventh, $508,538; Fresno, eighth, $457,307; followed in turn by Santa Clara, Mariposa, San Bernardino, San Benito, Shasta, Orange, and Del Norte, in the order

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named, each with a total between a half- and a quarter-million dollars value.

Paving Blocks.

The paving block industry has decreased materially of recent years, almost to the vanishing point, because of the increased construction of smoother pavements demanded by motor-vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Placer, Riverside, San Bernardino, and San Diego are of granite.

Production in 1925 amounted to 27 M, valued at $1,350.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1907	4,604	$199,347
1888	10,500	367,500	1908	7,660	334,780
1889	7,303	297,236	1909	4,503	199,803
1890	7,000	245,000	1910	4,434	198,916
1891	5,000	150,000	1911	4,141	210,819
1892	*3,000	96,000	1912	11,018	578,355
1893	2,770	96,950	1913	6,364	363,505
1894	2,517	66,981	1914	6,053	270,598
1895	2,332	73,338	1915	3,285	171,092
1896	4,161	77,584	1916	1,322	54,362
1897	1,711	35,235	1917	938	38,567
1898	1,144	21,725	1918	372	17,000
1899	305	7,861	1919	27	1,350
1900	1,192	23,775	1920	63	3,155
1901	1,920	41,075	1921	4	280
1902	3,502	112,437	1922	72	3,924
1903	4,854	134,642	1923	15	880
1904	3,977	161,752	1924	11	935
1905	3,408	134,347	1925	27	1,350
1906	4,203	173,432	Totals	135,702	$5,315,888

* Figures for 1887-1892 (inc.) are for Sonoma County only, as none are available for other counties during that period; though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, due to the war, there was a serious inquiry for domestic sources of supply. One of the shipments made in that year was of pebbles selected from gold-dredger tailings in Sacramento County, for use in a gold mill in Amador County employing Hardinge mills.

The important development in this item, however, took place in San Diego County. At several points along the ocean shore from Encinitas south to near San Diego, there are beaches of washed pebbles varying from 1 inch to 6 inches in diameter, which come from conglomerate beds made up of well-rounded water-worn pebbles of various granitic and porphyritic rocks with some felsite and flint. The wave action has broken down portions of the cliffs for considerable distances and formed beaches of the pebbles which are well washed and cleaned of the softer materials. The rocks sorted out for shipment are mainly

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basalt and diabase, with an occasional felsite and flint pebble. There is a tough black basalt which is stated to give satisfactory results. In Fresno County pebbles have been selected from the gravel beds of the San Joaquin River near Friant. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah.

Imports in 1925 amounted to 14,500 long tons, valued at $105,041 compared with 15,601 long tons and $114,958 in 1924.

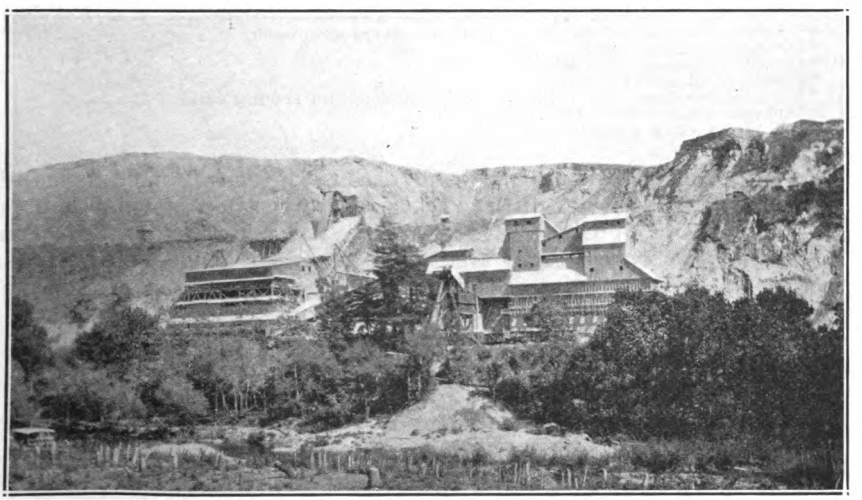
Californian output for 1925 was 215 tons, valued at $1,385, a decrease from the 1924 figures.

The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,268
1919	2,607	19,272
1920	2,104	17,988
1921	247	1,418
1922	1,571	7,628
1923	2,650	14,936
1924	434	2,969
1925	215	1,385
Totals	60,478	$257,779

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.



Plant of Granite Rock Company at Logan, San Benito County. The quarry face shows above and to the left of the buildings. Photo by C. McK. Laizure.

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The distribution of the 1925 output of sand and gravel, by counties, is given in the following table:

County	*Tons*	*Value*
Alameda	[a] 1,642,874	$1,024,891
Amador	18,850	21,200
Butte	86,727	57,592
Calaveras	1,719	1,305
Contra Costa	[a] 106,245	43,470
Del Norte	1,000	750
El Dorado	7,153	10,220
Fresno	577,071	249,527
Glenn	248,600	91,926
Humboldt	164,875	98,169
Imperial	166,940	138,294
Kern	6,000	3,000
Lake	25,500	15,300
Lassen	1,000	750
Los Angeles	[b] 4,591,655	2,869,229
Mariposa	817,735	328,794
Merced	67,333	27,300
Modoc	8,200	2,000
Mono	[c] 15,000	29,250
Monterey	[d] 264,927	209,423
Napa	35,029	25,015
Nevada	3,750	3,000
Orange	[e] 343,487	235,112
Placer	451,160	48,707
Riverside	[a] 13,270	13,542
Sacramento	[af] 392,742	228,552
San Benito	69,066	73,175
San Bernardino	427,791	206,251
San Diego	[a] 539,210	384,965
San Francisco	[a] 18,500	16,250
San Joaquin	569,579	102,737
San Mateo	46,090	29,798
Santa Barbara	80,994	57,243
Santa Clara	406,280	345,049
Santa Cruz	[a] 18,666	14,625
Shasta	82,517	59,829
Sierra	5,200	3,050
Siskiyou	10,960	8,200
Solano	15,000	12,000
Sonoma	160,153	63,543
Stanislaus	224,426	172,256
Tehama	6,000	4,000
Tulare	25,235	12,735
Tuolumne	6,600	2,500
Ventura	[a] 132,133	105,800
Yolo	38,430	23,060
Yuba	[a] 222,558	137,288
Colusa, Madera, Marin, Mendocino, Plumas*	151,678	111,575
Totals	13,315,908	$7,722,247

* Combined to conceal output of a single operator in each.
[a] Includes molding sand.
[b] Includes plaster and brick sand.
[c] Crushed volcanic cinders.
[d] Includes molding, blast, filter, stucco, plaster, and roofing sand.
[e] Includes plaster sand and roofing gravel.
[f] Includes roofing gravel.

Included in the above is a total of 45,964 tons of molding sand, valued at $76,974 f.o.b. pit, from two operators in Alameda County, and one each in Contra Costa, Monterey, Riverside, Sacramento, San Diego, San Francisco, Santa Cruz, Ventura, and Yuba. This item is each year assuming a more important position in the commercial mineral list of California. The 1924 figures totaled 32,968 tons and $68,105.

Crushed Rock.

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In

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many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis of like operations.

The values given are based on the selling prices, f.o.b. cars, barges, or trucks, at the quarry.

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Crushed Rock Production, by Counties, for 1925.

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	112,875	$81,484	150	$720	172,877	$290,419	[a]15,214	$16,884	301,116	$389,507
Alpine	500	300							500	300
Butte	5,333	4,000					[b]20,431	95,146	95,764	99,146
Contra Costa	132,427	117,805	5,396	2,787	275,741	285,700	359,002	258,397	772,566	664,689
Del Norte	1,700	2,900	153,000	266,000					154,700	268,900
Humboldt	20,955	32,448	147,015	548,819			15,248	20,304	183,218	601,571
Lassen	500	500							500	500
Los Angeles	1,370,705	1,124,914	147,480	294,816	2,442,391	1,824,794	[bd]1,232,077	864,852	5,192,653	4,109,376
Marin			9,185	11,940			236,680	228,964	245,865	240,904
Mariposa	26,500	79,500			9,333	14,000	[be]3,600	14,500	39,433	108,000
Mendocino	20,415	8,603							20,415	8,603
Napa	15,200	12,870			125,267	125,400	11,584	13,901	152,051	152,171
Nevada	6,273	7,333							6,273	7,333
Placer	22,248	33,581	3,000	3,900	27,654	31,802			52,902	69,283
Riverside			153,416	200,278	438,586	325,000	[f]140	1,900	592,142	527,178
Sacramento	52,160	36,080	2,479	1,363	1,496	1,964	403,000	322,400	459,135	361,807
San Bernardino	5,000	12,600	109,464	131,539	26,666	25,000	11,877	19,658	153,007	188,797
San Diego	15,985	7,500	9,403	11,331	87,433	99,557	12,944	3,750	125,765	122,138
San Francisco	30,353	38,499			59,140	76,409			89,493	114,908
San Luis Obispo	59,820	50,113							59,820	50,113
San Mateo	25,969	36,324			16,217	23,510	667	1,125	42,853	60,959
Santa Barbara	10,000	7,500					34,533	41,922	44,533	49,422
Santa Clara	1,200	1,500					139,656	106,724	140,856	108,224
Shasta	56,124	66,012			136,636	170,112	43,104	53,664	235,864	289,788
Sierra	173	377			500	250			673	627
Siskiyou	10,700	15,600							10,700	15,600
Sonoma	33,587	25,475	260	195	20,444	30,333			54,291	55,003
Tehama	26,249	63,983			3,320	5,000			29,569	68,983
Trinity					200	2,000	2,000	3,000	2,200	5,000
Tuolumne	6,333	3,688			[b]450	788	[bg]3,591	22,761	10,374	27,237
Ventura					21,528	16,146	10,405	9,074	31,933	25,220
Amador, Calaveras, El Dorado, Merced, San Benito, Solano, Stanislaus, Sutter, Tulare*	448,991	322,498							448,991	322,498
Imperial and Madera*			60,589	13,498					60,589	13,498
Fresno, Glenn, Orange, San Benito, San Joaquin, Santa Cruz, Tulare*					310,669	228,705			310,669	228,705
Amador[a], Calaveras[c], Fresno, Solano*							381,816	327,884	381,816	327,884
Totals	2,518,275	$2,193,987	800,837	$1,487,186	4,176,548	$3,576,889	3,007,569	$2,426,810	10,503,229	$9,684,872

*Combined to conceal output of a single operator in each.
[a] Includes red roofing granules.
[b] Includes granules for roofing and stucco dash.
[c] Includes greenstone roofing granules.
[d] Includes granite grit for poultry.
[e] Includes jasper roofing granules.
[f] Includes black granite for stucco granules.
[g] Includes dolomitic marble for terazzo.
[h] Includes limestone dust for concrete filler.
[i] Includes mariposite for stucco dash granules.

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Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1910	5,827,828	$2,777,690
1894	661,900	664,838	1911	6,487,223	3,610,357
1895	1,254,688	1,095,939	1912	8,044,937	4,532,598
1896	960,619	839,884	1913	9,817,616	4,823,056
1897	821,123	600,112	1914	9,288,397	3,960,973
1898	1,177,365	814,477	1915	10,879,497	4,609,278
1899	964,898	786,892	1916	9,951,089	4,009,590
1900	789,287	561,642	1917	8,069,271	3,505,662
1901	530,396	641,037	1918	6,641,144	3,325,889
1902	2,056,015	1,249,529	1919	6,919,188	3,678,322
1903	2,215,625	1,673,591	1920	9,792,122	6,782,414
1904	2,296,898	1,641,877	1921	10,914,145	7,834,640
1905	2,624,257	1,716,770	1922	13,049,644	10,366,231
1906	1,555,372	1,418,406	1923	19,840,301	15,379,838
1907	2,288,888	1,915,015	1924	21,451,129	15,962,476
1908	3,998,945	3,241,774	1925	23,819,137	17,407,113
1909	5,531,561	2,708,326	Totals	210,891,605	134,592,311

A comparison of the above table of annual production of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902.

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CHAPTER FIVE.

INDUSTRIAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXII (inc.). Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly-defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material.

The more important of these minerals thus far exploited, so far as shown by value of the output, are limestone, mineral water, pyrites, pottery clays, diatomaceous earth, gypsum, talc, and dolomite.

This group as a whole showed a slight increase in the total value to $5,379,064 in 1925 from $5,112,812 for 1924.

The following table gives the comparative figures for the amounts and values of industrial minerals produced in California during the years 1924 and 1925:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	70 tons	$4,750	*	*	* —
Clay (pottery)	417,928 tons	651,857	537,587 tons	$674,376	$22,519+
Dolomite	28,843 tons	71,271	42,852 tons	104,900	33,629+
Feldspar	9,055 tons	68,112	8,165 tons	59,615	8,497—
Fuller's earth	5,290 tons	67,295	5,280 tons	91,842	24,547+
Gems		4,800		10,663	5,863+
Gypsum	25,569 tons	53,210	107,613 tons	172,444	119,234+
Limestone	219,476 tons	582,660	319,977 tons	494,525	88,135—
Lithia	109 tons	2,269			2,269—
Mineral paint	532 tons	5,234	669 tons	6,969	1,735+
Mineral water	8,159,211 gals.	818,726	12,115,072 gals.	1,230,455	411,729+
Pumice and volcanic ash	4,919 tons	33,404	5,319 tons	32,937	467—
Pyrites	124,214 tons	517,835	129,500 tons	528,550	10,.15+
Silica (sand and quartz)	6,808 tons	35,006	12,498 tons	96,780	61,774+
Soapstone and talc	16,179 tons	242,770	15,465 tons	239,084	3,686—
Unapportioned		[a]1,953,613		[b]1,635,924	317,689—
Total value		$5,112,812		$5,379,064	
Net increase					$266,252+

*Under 'unapportioned.'

[a] Includes diatomaceous earth, shale oil, sillimanite-andalusite, sulphur, mica schist, radio galena crystals.

[b] Includes asbestos, diatomaceous earth, graphite, shale oil, sillimanite-andalusite.

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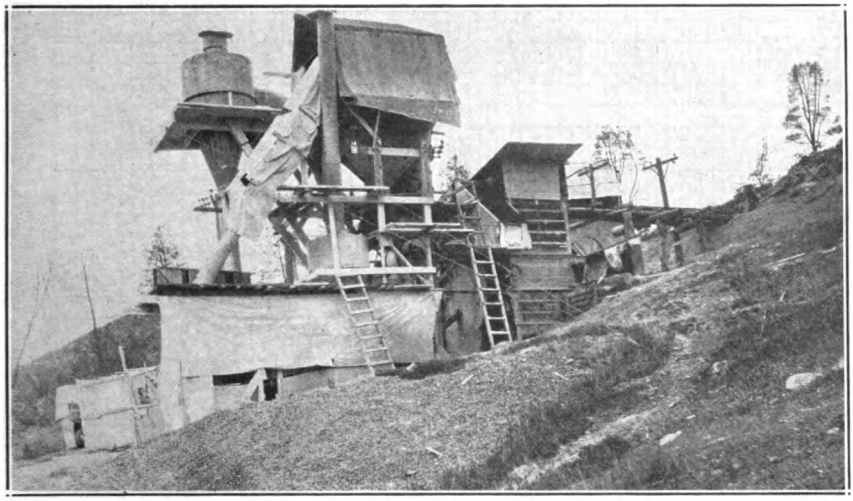
ASBESTOS.

Bibliography: State Mineralogist Reports XII-XIX (inc.), XXII. Bulletins 38, 91. Canadian Dept. of M., Mines Branch Bulletin 69. Min. & Sci. Press, April 10, 1920, pp. 531-533. Eng. & Min. Jour.-Press, Vol. 113, pp. 617-625, 670-677.

In 1925 there was a small tonnage of crude asbestos ore and fibre produced in California, but as there was only a single operator, the figures are concealed under the 'Unapportioned' item.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Cala-



Asbestos fiberizing mill of the San Benito Asbestos Company, San Benito County. Photo by C. McK. Laizure.

veras, and Monterey counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada Mountains which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

Three-quarters of the world's supply of asbestos is produced by Canada. The accompanying chart shows the range of prices at Quebec, 1922-1925 (inc.).

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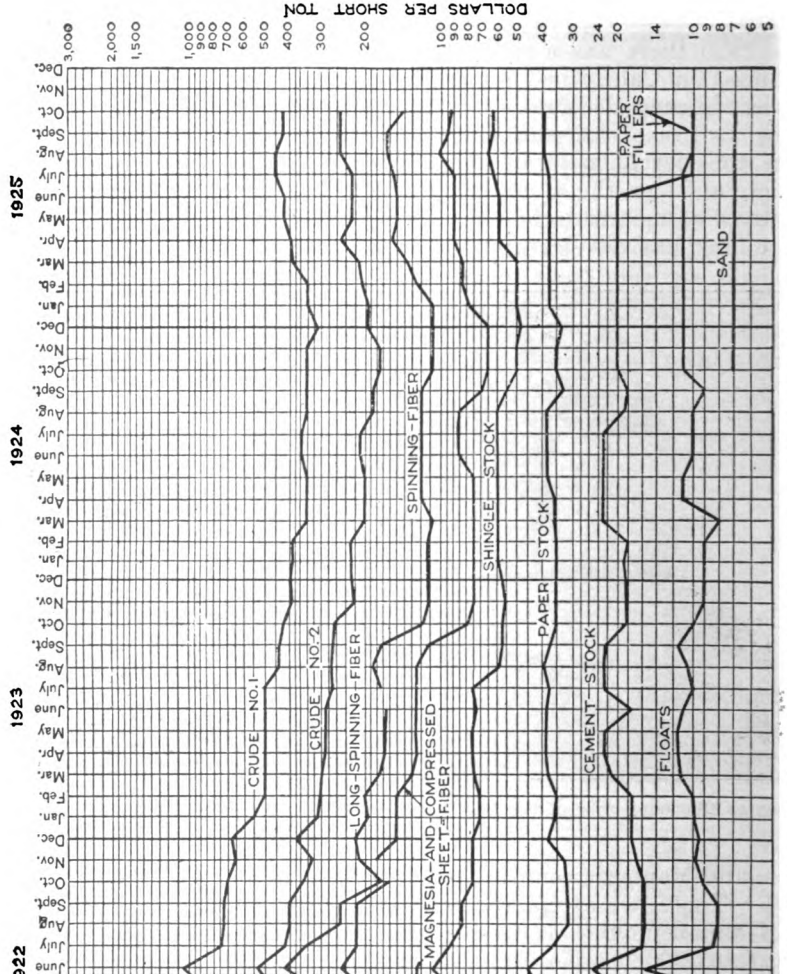

Prices of Canadian asbestos, "crude" and "fiber," f.o.b., Quebec, 1922–1925. From U. S. Bureau of Mines.

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Asbestos Production of California, by Years.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1907	70	$3,500
1888	30	1,800	1908	70	6,100
1889	30	1,800	1909	65	6,500
1890	71	4,260	1910	200	20,000
1891	66	3,960	1911	125	500
1892	30	1,830	1912	90	2,700
1893	50	2,500	1913	47	1,175
1894	50	2,250	1914	51	1,530
1895	25	1,000	1915	143	2,860
1896			1916	145	2,380
1897			1917	136	10,225
1898	10	200	1918	229	9,903
1899	30	750	1919 / 1920 *	131	6,240
1900	50	1,250			
1901	110	4,400	1921	410	19,275
1902			1922	50	1,800
1903			1923	20	200
1904	10	162	1924	70	4,750
1905	112	2,625	1925	*	*
1906	70	3,500	Totals	2,826	$133,725

*Annual details concealed under 'Unapportioned.'

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XXI. Bulletin 38. Eng. & Min. Jour.-Press, Vol. 114, p. 109, July 15, 1922; Vol. 115, pp. 319-324, Feb. 17, 1923.

There were no commercial shipments of crude barytes in California during 1924-1925. In 1923, the output amounted to a total of 2925 tons valued at $16,058 f. o. b. rail-shipping point. The 1923 product came mainly from Nevada County, with smaller amounts from Mariposa and Shasta counties, and was consumed principally in the manufacture of lithopone. More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared, white pigment containing approximately 70% barium sulphate and 30% zinc sulphide. This is one of the principal constituents of 'flat' wall paints.

The principal uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleum, oilcloth and rubber manufacture, and in the preparation of lithopone and a number of chemicals. The most important of such chemicals, other than lithopone, are: barium binoxide (used in preparation of hydrogen peroxide); barium carbonate (used by pressed brick and by rubber manufacturers to neutralize sulphur content); barium chloride (used in battery plates, and as a mordant by dry-color manufacturers, and in tanning leather); barium nitrate (used in munitions and in making 'red fire' material); barium sulphate precipitated, or 'blanc fixe' (used in rubber manufacture; for painting on interior steel of battleships and other sea-going vessels; also as a detector in taking X-ray pictures of the human body).

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Present quotations for barytes vary from $7 to $9 per ton, crude, f.o.b. rail-shipping point, depending on quality. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Total Barytes Production of California.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1918	100	$1,500
1911	309	2,207	1919	1,501	18,065
1912	564	2,812	1920	3,029	20,795
1913	1,600	3,680	1921	901	4,809
1914	2,000	3,000	1922	3,370	18,925
1915	410	620	1923	2,925	16,058
1916	1,606	5,516	1924	----------	----------
1917	4,420	25,633	1925	----------	----------
			Totals	23,595	$129,260

CLAY (Pottery).

Bibliography: State Mineralogist Reports I, IV, IX, XII-XV, XVIII-XXII (inc.). Bulletin 38. Preliminary Report No. 7. U. S. Bureau of Standards, Tech. Paper No. 262.

At one time or another in the history of the state, pottery clay has been quarried in thirty-three of its counties. Of these, 20 contributed in 1925. In this report, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flowerpots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and hollow building blocks.

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly-finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps.

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During 1925, a total of 58 producers in 20 counties reported an output of 537,587 short tons of pottery clay, having a total value of $674,376 f. o. b. rail-shipping point, for the crude material, as compared with the 1924 production of 417,928 tons worth $651,858.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1925, is shown herewith:

Pottery Clay, in 1925.

County	Tons	Value	Used in the manufacture of—
Alameda	9,300	$11,376	Drain, floor, faience, hand made and roofing tile, sewer and chimney pipe, flue lining.
Amador	63,889	95,946	Kalsomine, refractories, roofing tile, saggers, sanitary ware, sewer pipe, and various.
Los Angeles	217,707	106,817	Drain, faience, floor, roofing tile, sewer pipe, flue lining, fire clay, electrical conduit, refractories, various and oil well mudding.
Monterey	414	1,161	Floor and roofing tile.
Orange	13,431	42,562	Refractories, drain tile and various.
Placer	102,598	138,813	Architectural terra cotta, sewer and chimney pipe, flue lining, drain, floor and roofing tile, and various.
Riverside	74,789	155,315	Sewer pipe, drain tile, refractories, stoneware, and various.
Sacramento	1,363	2,748	Drain tile and various.
San Bernardino	[a]1,540	11,000	Porcelain.
San Diego	[b]26,976	66,427	Porcelain, stoneware, floor tile, architectural terra cotta, and various.
Santa Barbara	2,390	5,800	Drain, floor and roofing tile.
Santa Clara	1,516	3,216	Red earthenware, sewer pipe, roofing and drain tile.
Calaveras, Contra Costa, Fresno, Humboldt, Kern, Marin, Merced, Sonoma*	21,674	33,195	Drain and roofing tile, sewer and chimney pipe, flue lining, architectural terra cotta, crushed brick for roofing, porcelain and various.
Totals	537,587	$674,376	

*Combined to conceal output of a single operator in each.
[a] Includes kaolin.
[b] Includes 'Cornwall' stone.

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Pottery Clay Products.

The values of the various pottery clay products made in California during 1925 totaled $13,621,431, compared with $12,015,361 in 1924. their distribution being shown in the following tabulation:

Product	*Number of producers*	*Tons*	*Value*
Architectural terra cotta	6	17,068	$2,677,855
Chimney pipe, terra cotta and flue lining	9	14,484	535,887
Drain tile	13	7,733	126,360
Roofing tile	18	48,327	1,394,108
Sewer pipe	10	88,360	2,217,151
Stoneware and chemical stoneware	6	----	362,370
Sanitary ware	5	----	2,178,623
Chinaware and semi-vitreous tableware	3	----	569,182
Red earthenware	6	----	164,071
Floor, faience, mantel, glazed and hand-made tile	20	----	2,419,583
Miscellaneous art pottery, bisque doll heads and chinaware, porcelain, cement, brick dust, glass tank blocks, garden furniture, crushed tile, electrical conduit, conduit pipe, fire tile and ground fire clay	14	----	976,241
Total value			$13,621,431

Important increases were shown by several of the above groups, particularly chimney pipe, sewer pipe, roofing tile, and flat tile (floor, faience, mantel, etc.).

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1907	160,385	$254,454
1888	75,000	37,500	1908	208,042	325,147
1889	75,000	37,500	1909	299,424	465,647
1890	100,000	50,000	1910	249,028	324,099
1891	100,000	50,000	1911	224,576	252,759
1892	100,000	50,000	1912	199,605	215,683
1893	24,856	67,284	1913	231,179	261,273
1894	28,475	35,073	1914	179,948	167,552
1895	37,660	39,685	1915	157,866	133,724
1896	41,907	62,900	1916	134,636	146,538
1897	24,592	30,290	1917	166,298	154,602
1898	28,947	33,747	1918	112,423	166,788
1899	40,600	42,700	1919	135,708	245,019
1900	59,636	60,956	1920	203,997	440,689
1901	55,679	39,144	1921	225,120	362,172
1902	67,933	74,163	1922	277,232	473,184
1903	90,972	99,907	1923	376,863	697,841
1904	84,149	81,952	1924	417,928	651,857
1905	133,805	130,146	1925	537,587	674,376
1906	167,267	162,283	Totals	5,909,323	$7,636,134

DOLOMITE.

Bibliography: Reports XV, XVII–XXII (inc.). Bulletins 67, 91.

The production of dolomite for the year 1925 totaled 42,852 tons valued at $104,900, being an increase in both quantity and value over the 1924 figures of 28,843 tons and $81,271, though less than the record yield of 1923. The 1925 output came from two quarries in Inyo County and one each in San Benito and Tuolumne. The material

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shipped was utilized for steel furnace flux and refractories, for manufacture of CO_2, burned dolomitic lime, for stucco dash-coat, and terrazzo.

Dolomite Production of California, by Years.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included under limestone, as the two minerals are closely related chemically; but since dolomite, as such, has been found to have certain distinctive applications, we have given it a separate classification.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
1922	52,409	114,911
1923	69,519	142,615
1924	28,843	71,271
1925	42,852	104,900
Totals	361,684	$940,523

FELDSPAR.

Bibliography: State Mineralogist Reports XV, XVII, XVIII, XXI. Bulletins 67, 91. U. S. Bureau of Mines, Bulletin 92. Eng. & Min. Jour.-Press, Vol. 115, pp. 535–538, Mar. 24, 1923.

Feldspar was produced by eight operators in three counties (Kern, Riverside, and San Diego) during 1925, to the amount of 8165 tons, valued at $59,615, being a slight decrease both in quantity and value from the 1924 figures, which were 9055 tons and $68,112.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende, and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

Present quotations are from $5 to $8 per ton, crude, according to quality.

The most important recent developments in the feldspar resources of California have taken place in San Diego and Riverside counties, where large deposits of massive, high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The important producing districts are near Lakeside and Campo, in San Diego County,

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and near Lakeview, Murrietta, and Elsinore, in Riverside County. No recent shipments have been reported from Monterey and Tulare counties, formerly important sources.

Total Feldspar Production of California.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1919	1,272	$12,965
1911	740	4,560	1920	4,518	26,189
1912	1,382	6,180	1921	4,349	28,343
1913	2,129	7,850	1922	4,587	37,109
1914	3,530	16,565	1923	11,100	81,800
1915	1,800	9,000	1924	9,055	68,112
1916	2,630	14,350	1925	8,165	59,615
1917	11,792	46,411			
1918	4,132	22,061	Totals	71,941	$446,825

FLUORSPAR.

Bibliography: State Mineralogist Reports XVII, XVIII. Bulletins 67, 91. Eng. & Min. Jour.-Press, Vol. 117, pp. 489–492, Mar. 22, 1924.

Fluorspar, or calcium fluoride, CaF_2, is one of the most important non-metallic minerals from an industrial standpoint. About 80% of the commercial mineral is prepared in the 'gravel' form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found. In the United States, under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacturing of enameled ware, glazed tile and brick, opalescent glass and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms: lump, gravel, and ground.

[1] "Of the three physical forms of fluorspar of commerce, lump, gravel, and ground, two grades of each form are marketed. Lump and gravel are sold as metallurgical or fluxing grades, and acid grades; ground is sold as glass-enamel-ceramic grade, and acid grade. Lump spar of either grade should not be too large, and small lump, not exceeding 6 in. in diameter, is preferred by the trade. Specifications for physical form of metallurgical lump spar demand a minimum content of gravel fluorspar, as fines, in any carload, say not exceeding one ton. Metallurgical gravel spar should not be too fine, and coarse gravel with minimum content of fluorspar sand, as fines, is more acceptable to the trade. Size specifications for metallurgical gravel spar demand that it shall pass through a 1-in. ring.

"The market specifications for standard fluorspar in any form are mainly chemical and governed by analysis. Guaranteed analysis for standard metallurgical or fluxing grade spar, lump or gravel, is minimum of 85 per cent calcium fluoride, and maximum of 5 per cent silica. Merchantable grade acid-spar, lump, gravel and ground, varies somewhat with different users. Not exceeding 2 per cent silica and under 97 per cent calcium fluoride are the limits. Part of the trade insists on a guaranteed minimum of 98 per cent calcium fluoride and maximum of 1 per cent silica, though some consumers are satisfied with a guaranteed minimum of 97 per cent calcium fluoride and maximum of 2 per cent silica. Glass-enamel-ceramic grade ground fluorspar specifications are flexible, the users of that class of spar particularly demanding fine grinding, preferably 150 to 200 mesh, and thorough washing free from alumina; also freedom from contamination of metallic ores and barytes. Analyses for glass-enamel-ceramic spar vary from 90 to 95 per cent calcium fluoride, 2 to 5 per cent silica, and 2 to 8 per cent calcium carbonate.

"The usual impurities in fluorspar are silica and calcium carbonate, which are penalized, as a rule. Minor impurities in fluorspar are ores of lead and zinc, generally

[1] Reed, A. H., Marketing of fluorspar: Eng. & Min. Jour.-Press, Vol. 117, p. 489, Mar. 22, 1924.

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the sulphides, and pyrites and barytes, all of which are objectionable, and sometimes penalized.

"No premiums are allowed on fluorspar shipments, but there is a penalty for inferior material. Trade specifications demand that for each point of calcium fluoride less than 85 per cent there shall be deducted 1/85th of the delivered cost, and for each point of silica over 5 per cent there shall be deducted 1/40th of the delivered cost."

According to the U. S. Bureau of Foreign and Domestic Commerce, imports of fluorspar into the United States in 1925 amounted to 43,482 long tons, valued at $468,847, and came principally from England, with smaller amounts from British South Africa, Italy, China, and Netherlands. Domestic shipments of fluorspar, according to the U. S. Geological Survey, totaled 113,669 short tons, valued at $2,052,342.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but no commercial production has resulted except in 1917–1918, when a total of 79 tons valued at $991 was shipped from Riverside County.

The Tariff Act of 1922 places a duty of $5.60 per ton on foreign importations of fluorspar.

Present quotations (Engineering and Mining Journal-Press, New York) are f.o.b. Middle Western Mines, per net ton: Gravel, not less than 85% CaF_2 and not over 5% SiO_2, $18; foundry lump, $20.

FULLER'S EARTH.

Bibliography: State Mineralogist Reports XIV, XVII, XVIII, XXI. Bulletins 38, 91. U. S. Bureau of Mines, Bulletin 71. Eng. & Min. Jour.-Press, Vol. 121, pp. 837–842, May 22, 1926.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo, and Kern counties.

Clays of the montmorillonite and halloysite group ('rock soap') are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

The production of 5280 tons valued at $91,842 here credited to 1925 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it, for the purpose of the State Mining Bureau's statistical reports, under the fuller's earth heading.

After all, the practical test of a fuller's earth is not so much chemical, as a physical one; that is, its physical capacity to adsorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1925 output above noted is a slight decrease in amount from the 5290 tons but an increase in value over the figure of $67,295 in 1924, and came from five properties, in Inyo, Kern, San Bernardino, and San Diego counties.

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The industrial applications of the montmorillonite (or 'bentonite,' as it is more commonly referred to) group of clays are numerous. According to Melhase:[1]

"Bentonite has been used to a limited extent in soaps and detergent preparations, in paints, pigments, and stove polish. Tests indicate that it may have a further field of usefulness in the manufacture of cements and plasters, in the ceramic industry, and in the preparation of dyes, emulsions, explosives, and fertilizers. Horticultural sprays, animal dips, lubricants, and absorbents may employ bentonite as an ingredient. Bentonite is used in de-inking newspapers, in foundry work, in the manufacture of pencils, crayons, and ink, and in the preparation of various pharmaceuticals and cosmetics.

"Bentonites in which the characterizing mineral is leverrierite are extensively used in the preparation of water softeners. The California bentonites are used chiefly by local refineries for cleaning heavy lubricating oils, kerosene, and gasoline. In preparing the bentonite for this purpose, it is first dried at a temperature of 230 deg. F. It is then ground to an impalpable powder and treated for several hours with 96 per cent sulphuric acid, about 45 per cent by weight of acid being found more efficient. The acid-soluble impurities being thus eliminated, the clay is then drained and thoroughly washed with clean water.

"Refining Processes.

"The prepared clay is then placed in agitators together with the oil to be treated and the mixture thoroughly agitated with steam at 240 to 300 deg. F. From the agitators the mixture goes to settling tanks and then to filter presses, which remove the suspended clay from the now decolorized oil. The amount of clay used ranges from 1 lb. per barrel for gasoline to 100 lb. per barrel for dark, heavy, lubricating oils. The efficiency of acid-treated bentonite is much greater than that of fuller's earth.

"When used in the treatment of gasoline or light oils the clay may be used several times without rejuvenation, but with the darker oils it becomes necessary to wash and rejuvenate the clay after each application. This process cannot, however, be continued indefinitely, as the clay loses a portion of its efficiency with each rejuvenation, and after the third treatment it is found more satisfactory to replace the old clay with a fresh supply."

Fuller's Earth Production of California, by Years.

Fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1914	760	$5,928
1900	500	3,750	1915	692	4,002
1901	1,000	19,500	1916	110	550
1902	987	19,246	1917	220	2,180
1903	250	4,750	1918	37	333
1904	500	9,500	1919	385	3,810
1905	1,344	38,000	1920	600	6,000
1906	440	10,500	1921	1,185	8,295
1907	100	1,000	1922	6,606	48,756
1908	50	1,000	1923	3,650	55,125
1909	459	7,385	1924	5,290	67,295
1910	340	3,820	1925	5,280	91,842
1911	466	5,294			
1912	876	6,500	Totals	33,207	$440,461
1913	460	3,700			

NOTE.—Above production since 1921 has been montmorillonite (hydrous aluminum silicate) a collodial clay, sometimes called 'rock soap' and 'bentonite,' and in part locally called 'shoshonite' from its being found near Shoshone in Inyo County; and in part 'otaylite' from Otay, San Diego County.

GEMS.

Bibliography: State Mineralogist Reports II, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 37, 67, 91. U. S. G. S., 'Mineral Resources of the U. S.'; Bull. 603, p. 208. Bull. Dept. Geol.

[1] Melhase, John, Mining bentonite in California: Eng. & Min. Jour.-Press, Vol. 121, p. 842, May 22, 1926.

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Univ. of Cal., Vol. 5, pp. 149–153, 331–380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed for the most part in a small way. The material reported in 1925 totaled $10,663 in value, compared with $4,800 in 1924; the increase being due mainly to San Diego County.

The following table shows the distribution of rough, uncut gem and jeweler's materials during 1925:

County	*Value*	*Kind*
San Diego	$9,413	Tourmaline, spessartite garnet, hyacinth, pink and aquamarine beryl, quartz, blue topaz.
Butte, Calaveras, San Mateo	* 1,250	Diamonds. Quartz crystals. Jasper.
Total value	$10,663	

*Combined to conceal the output of a single operator in each.

Varieties of California's Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green, also a blue tourmaline has been found.

One of our California gem stones, *bentonite*, has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of *vesuvianite*, and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodondite* has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

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Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Sapphires have been reported recently found in San Bernardino and Riverside counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occuring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1914	$3,970
1901	40,000	1915	3,565
1902	162,100	1916	4,752
1903	110,500	1917	3,049
1904	136,000	1918	650
1905	148,500	1919	5,425
1906	497,090	1920	36,056
1907	232,642	1921	10,954
1908	208,950	1922	1,312
1909	193,700	1923	13,220
1910	237,475	1924	4,800
1911	51,824	1925	10,663
1912	23,050		
1913	13,740	Total value	$2,174,487

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII. Bulletins 67, 91. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price.

The principal value of graphite is on account of its infusibiilty and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention

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of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material, the best quality crystalline variety being quoted at present (f.o.b. New York) at 9¢–9¼¢ per pound (Ceylon lumps).

The coarser flakes are necessary for crucibles, as they help to bind the clay together in addition to their refractory service. Imports in 1925 from Ceylon, Canada, Madagascar, Mexico and Korea, totaled 17,780 short tons valued at $828,082 compared with 16,380 tons valued at $399,511 in 1924.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1925 there was a small commercial output of graphite from Inyo County. For several years a single plant in Los Angeles County was concentrating graphite from a disseminated ore, the product being used for paint and for foundry facing.

Graphite Production of California, by Years.

According to the records of the State Mining Bureau, the graphite production of California, by years, has been as follows:

Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903		
1913	2,500	25
1914		
1915		
1916	29,190	2,335
1917		
1918	*770,000	37,225
1919		
1920		
1921	*624,000	26,160
1922		
1923		
1925	*	*
Totals	1,637,690	$71,905

*Annual details concealed under 'Unapportioned,' on account of a single producer.

GYPSUM.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XXII. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 223, 413, 430, 697.

During 1925, one operator in Imperial County and three in Riverside produced a total of 107,613 tons of gypsum, valued at $172,444, compared with 25,569 tons and $53,210 in 1924 and 86,410 tons worth $188,336 in 1923. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster (including wall board), and for fertilizer. The increase over the 1924 figures is due mainly to the larger scale of operations of the Pacific Portland Cement Company's gypsum plant in western Imperial County.

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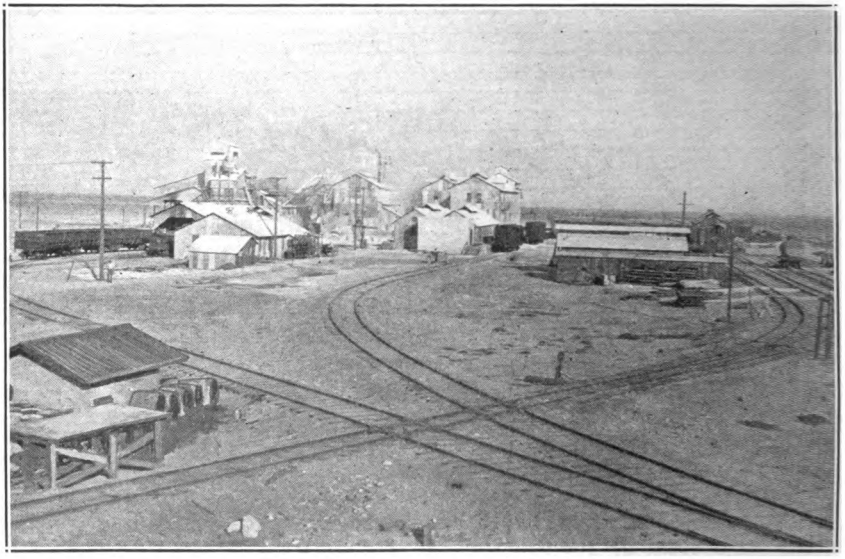
Gypsum deposit of Pacific Portland Cement Company in the Fish Mountains, Imperial County. Photo by W. B. Tucker.



300-ton plaster mill of Pacific Portland Cement Company at Plaster City, Imperial County. Photo by W. B. Tucker.

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Uses.

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2%, by weight, raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application, the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1907	8,900	$57,700
1888	2,500	25,000	1908	34,600	155,400
1889	3,000	30,000	1909	30,700	138,176
1890	3,000	30,000	1910	45,294	129,152
1891	2,000	20,000	1911	31,457	101,475
1892	2,000	20,000	1912	37,529	117,38[illegible]
1893	1,620	14,280	1913	47,100	135,056
1894	2,446	24,584	1914	29,734	78,375
1895	5,158	51,014	1915	20,200	48,953
1896	1,310	12,580	1916	33,384	59,533
1897	2,200	19,250	1917	30,825	56,840
1898	3,100	23,600	1918	19,695	37,176
1899	3,663	14,950	1919	19,813	50,579
1900	2,522	10,088	1920	20,507	92,535
1901	3,875	38,750	1921	37,412	78,875
1902	10,200	53,500	1922	47,084	188,336
1903	6,914	46,441	1923	86,410	289,136
1904	8,350	56,592	1924	25,569	53,210
1905	12,859	54,500	1925	107,613	172,444
1906	21,000	69,000			
			Totals	814,234	$2,681,462

INFUSORIAL and DIATOMACEOUS EARTH.

Bibliography: State Mineralogist Reports II, XII–XVI (inc.), XV, XVII–XXII (inc.). Bulletins 38, 67, 91. Am. Inst. Min. Eng., Bull. 104, August, 1915, pp. 1539–1550. U. S. Bur. of Mines, Rep. of Investigations: Serial No. 2431, Jan., 1923. Eng. & Min. Jour.-Press, Vol. 115, pp. 1152–1154, June 30, 1923.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat, where high temperatures are

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employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes and safes, and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier maché, and for solidifying bromide. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

As over 90% of the output in California is from a single operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were nine operators in 1925 in Monterey, Santa Barbara, and Shasta counties, the shipments showing an increase in tonnage, but a decrease in total value compared with 1924.

The material shipped was utilized for insulation, filtration, paint pigment, and for clarification of gasoline and kerosene.

Total Production of Diatomaceous Earth in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1908	2,950	$32,012
1890			1909	500	3,500
1891			1910	1,843	17,617
1892			1911	2,194	19,670
1893	50	2,000	1912	4,129	17,074
1894	51	2,040	1913	8,645	35,968
1895			1914	12,840	80,350
1896			1915	12,400	62,000
1897	5	200	1916	15,322	80,649
1898			1917	24,301	127,510
1899			1918	35,963	189,459
1900			1919	40,200	217,800
1901			1920	60,764	1,056,260
1902	422	2,532	1921	*90,739	1,016,675
1903	2,703	16,015	1922		
1904	6,950	112,282	1923	*193,064	524,035
1905	3,000	15,000	1924		
1906	2,430	14,400	1925		
1907	2,531	28,010	Totals	5,729,736	$8,881,0[illegible]

*Annual details concealed under 'Unapportioned.'

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LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII–XV (inc.), XVII–XXII (inc.). Bulletins 38, 91. Oregon Agr. College, Extension Bulletin 305. Eng. and Min. Jour.-Press, Vol. 120, pp. 249–253.

'Industrial' limestone was produced in eleven counties during 1925, to the amount of 319,977 tons, valued at $494,525, being an increase in quantity but a drop in value compared to the 1924 output of 219,476 tons, worth $582,660.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. That indicated in the table below as coming from Santa Clara and Los Angeles counties is calcareous marl sold for agricultural purposes. Of the total product in 1925, approximately 12,000 tons, valued at $46,250, was used for agricultural purposes.

Distribution of the 1925 output was as follows:

County	*Tons*	*Value*
El Dorado	228,293	$297,127
San Bernardino	13,239	27,569
Santa Cruz	16,551	33,102
Shasta	24,395	28,480
Tulare	13,300	43,900
Contra Costa, Inyo, Los Angeles, Santa Clara, Siskiyou, Tuolumne*	24,199	64,347
Totals	319,977	$494,525

*Combined to conceal output of a single operator in each.

Limestone Production of California, by Years.

The following tabulation gives the amounts and value of 'industrial' limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included.

Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1911	516,398	$452,790
1895	71,355	71,690	1912	613,375	570,248
1896	68,184	71,112	1913	301,918	274,455
1897	36,796	38,556	1914	572,272	517,713
1898	27,686	24,548	1915	146,324	156,288
1899	30,769	29,185	1916	187,521	217,733
1900	32,791	31,532	1917	237,279	356,396
1901	76,937	99,445	1918	208,566	456,258
1902	71,422	90,524	1919	88,291	248,145
1903	125,919	163,988	1920	90,120	298,197
1904	40,207	87,207	1921	75,921	305,912
1905	192,749	323,325	1922	84,382	282,181
1906	80,262	162,827	1923	143,266	348,464
1907	230,985	406,041	1924	219,476	582,660
1908	273,890	297,264	1925	319,977	494,525
1909	337,676	419,921			
1910	684,635	581,208	Totals	6,202,769	$8,479,613

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LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV, XXI. Bulletins 38, 67, 91.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915, though there was none shipped in 1925. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1917	880	$8,800
1900	440	11,000	1918	4,111	73,998
1901	1,100	27,500	1919	800	14,400
1902	822	31,880	1920	10,046	153,502
1903	700	27,300	1921	*1,365	20,781
1904	641	25,000	1922		
1905	25	276	1923		
1906			1924	109	2,269
1915	91	1,365	1925		
1916	71	1,065	Totals	21,325	$403,736

*Annual details concealed under 'Unapportioned.'

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 740; Min. Res. of U. S. Eng. & Min. Jour.-Press, Vol. 115, pp. 55–60, Jan. 13, 1923.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	*Tons*	*Value*
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

Classification and Uses.

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch; splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ x 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

As a heat-resisting transparent medium, sheet mica has various uses. It is widely employed for stove windows, though this use has declined

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to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantles, and also for military lanterns and in lantern slides.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, diver's helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle packings, in pipe and boiler coverings, in fire-proof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as 'Santa Claus snow' for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII-XIX (inc.), XXI, XXII. Bulletins 38, 91.

Mineral paint materials were produced in California in 1925 from properties in Stanislaus County, amounting to 669 tons valued at $6,969. This is an increase over the 532 tons and $5,234 of 1924, and was entirely of yellow ochre. Hematite has been shipped from Placer County, and red ochre from Sonoma and Ventura counties in former years.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value, since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1909	305	$2,325
1891	22	880	1910	200	2,040
1892	25	750	1911	186	1,184
1893	590	26,795	1912	300	1,800
1894	610	14,140	1913	303	1,780
1895	750	8,425	1914	132	847
1896	395	5,540	1915	311	1,756
1897	578	8,165	1916	643	3,960
1898	653	9,698	1917	520	2,700
1899	1,704	20,294	1918	728	4,738
1900	529	3,993	1919	1,780	17,055
1901	325	875	1920	779	8,477
1902	589	1,533	1921	446	4,748
1903	2,370	3,720	1922	1,620	13,277
1904	270	1,985	1923	1,049	11,773
1905	754	4,025	1924	532	5,234
1906	250	1,720	1925	669	6,969
1907	250	1,720			
1908	335	2,250	Totals	20,942	$200,851

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MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII-XVIII (inc.)., XXI. U. S. G. S., Water Supply Paper 338. Min. Res. 1914, 1916. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson, 1890. U. S. Dept. of Agr., Bur. of Chem., Bulletin 91.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing.

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least two localities in California: At The Geysers in Sonoma County, and Arrowhead Hot Springs in San Bernardino County. It doubtless exists at others, but the State Mining Bureau has not as yet had funds available to conduct the necessary investigations along this line.

So far as the efficacy of radioactivity in mineral water is concerned, it has been found by investigations of the U. S. Geological Survey and the U. S. Department of Agriculture that it is not retained and transported in bottled water. Radioactivity in water is only temporary, and dissipates. To obtain whatever therapeutic effect it may possess, radioactive water should be utilized directly at the spring.

Commercial production of mineral water in California for 1925 amounted to a total of 12,115,072 gallons valued at $1,230,455, being a new high record both in quantity and value. The 1925 output was distributed by counties, as follows:

County	*Gallons*	*Value*
Butte	4,484	$2,742
Lake	62,970	57,793
Los Angeles	3,811,270	336,038
Napa	63,836	44,251
San Diego	81,374	21,137
Sonoma	19,963	6,679
Calaveras, Colusa, Contra Costa, Fresno, Humboldt, Marin, Riverside, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano*	8,071,165	761,915
Totals	12,115,072	$1,230,455

*Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural and a large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value, as may be noted from the tabulation below.

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Mineral Water Production of California, by Years.

Mineral water was bottled for sale, at the Napa Soda Springs, Napa County, as early as 1860, and at other springs in California, notably The Geysers, Sonoma County, also at early dates; but there are no figures available earlier than the year 1887. Amounts and values, annually, since that year are shown herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1907	2,924,269	$544,016
1888	1,112,202	252,990	1908	2,789,715	560,507
1889	808,625	252,241	1909	2,449,834	465,488
1890	258,722	89,786	1910	2,335,259	522,009
1891	334,553	139,959	1911	2,637,669	590,654
1892	331,875	162,019	1912	2,497,794	529,384
1893	383,179	90,667	1913	2,350,792	599,748
1894	402,275	184,481	1914	2,443,572	476,169
1895	701,397	291,500	1915	2,274,267	467,738
1896	808,843	337,434	1916	2,273,817	410,112
1897	1,508,192	345,863	1917	1,942,020	340,566
1898	1,429,809	213,817	1918	1,808,791	375,650
1899	1,338,537	406,691	1919	2,233,842	340,117
1900	2,456,115	268,607	1920	2,391,791	421,643
1901	1,555,328	559,057	1921	3,446,278	367,476
1902	1,701,142	612,477	1922	4,276,346	486,424
1903	2,056,340	558,201	1923	5,487,276	616,919
1904	2,430,320	496,946	1924	8,159,211	
1905	2,194,150	538,700	1925	12,115,072	
1906	1,585,690	478,186	Totals	90,853,071	$16,587,791

PHOSPHATES.

Bibliography: State Mineralogist Report XXI. Bulletins 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XVIII, XXII. Bulletin 38 (See 'Tufa').

The production of pumice and volcanic ash for the year 1925 amounted to 5319 tons valued at $32,937, and came from properties in Imperial, Inyo, Kern, and Mono counties. This is an increase in tonnage but slightly lower value compared with the 1924 shipments which were 4919 tons worth $33,404.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and was sold for abrasive purposes; the balance of the Mono material and that from Inyo and Kern was the volcanic ash, or tuff variety, and was employed in making soap and cleanser compounds. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

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Pumice Production of California, by Years.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1918	2,114	$28,669
1910	----------	----------	1919	2,388	43,657
1911	----------	----------	1920	1,537	25,890
1912	100	2,500	1921	406	6,310
1913	3,590	4,500	1922	613	4,248
1914	50	1,000	1923	2,936	16,309
1915	380	6,400	1924	4,919	33,404
1916	1,246	18,092	1925	5,319	32,937
1917	525	5,295	Totals	26,173	$229,711

PYRITES.

Bibliography: State Mineralogist Reports XVIII, XIX, XXII. Bulletins 38, 91. Min. and Sci. Press, Vol. 114, pp. 825, 840.

A total production of 129,500 short tons of pyrites, valued at $528,550, was reported shipped in California during 1925 from properties in Alameda, Mariposa, and Shasta counties. This was a slight increase both in tonnage and value over the figures of 124,214 tons and $517,835 in 1924.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% s.

This does not include the large quantities of pyrite, chalcopyrite and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

Pyrites Production in California, by Years.

The total recorded pyrites production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1912	69,872	$203,470
1899	5,400	28,620	1913	79,000	218,537
1900	3,642	21,133	1914	79,267	230,058
1901	4,578	18,429	1915	92,462	293,148
1902	17,525	60,306	1916	120,525	372,969
1903	24,311	94,000	1917	111,325	323,704
1904	15,043	62,992	1918	128,329	425,012
1905	15,503	63,958	1919	147,024	540,300
1906	46,689	145,895	1920	146,001	530,581
1907	82,270	251,774	1921	110,025	473,735
1908	107,081	610,335	1922	151,381	570,425
1909	457,867	1,389,802	1923	148,004	555,308
1910	42,621	179,862	1924	124,214	517,835
1911	54,225	182,954	1925	129,500	528,550
			Totals	2,519,684	$8,923,742

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SHALE OIL.

Bibliography: State Mineralogist Report XIX. U. S. Geol. Surv., Bulletins 322, 729. U. S. Bur. of Mines, Bull. 210. Eng. and Min. Jour.-Press, Vol. 118, No. 8, pp. 290–292, Aug. 23, 1924. Chem. & Met. Eng., Vol. 32, No. 6, Feb., 1925. Min. Congress Jour., Dec., 1924.

Oil Shale is defined by Gavin,[1] as follows:

"Oil shale is a compact, laminated rock of sedimentary origin, yielding over 33 per cent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum.

* * * * * * *

"Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation, or pyrolysis, yields oils somewhat similar to petroleum. These substances have been termed 'kerogen,' from two Greek words meaning producer of wax."

The Scottish oil shales are also known as 'torbanite.'

The so-called 'oil shales' of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in this state are part of the Monterey formation of Tertiary age, and physically and chemically are different from the oil shales of Scotland and from other oil shales in the United States. The mineral matter of this shale is diatomaceous; the beds that yield oil occur in massive formation; and when freshly broken smell strongly of petroleum. Most geologists consider the Monterey shales to have been the origin of the oil in some of the oil fields of California.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France, and Australia, it has not attained any great commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have been in operation in California for several years past, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants. Both plants report output for 1925, the amount and value being concealed under the 'unapportioned' item.

Shale Oil Production of California, by Years.

Year	*Barrels*	*Value*
1922 } 1923 } *	4,333	$44,262
1924 } 1925 } *	8,688	55,240
Totals	13,021	$99,502

*Annual details concealed under 'Unapportioned."

[1] Gavin, M. J., Oil shale, an historical, technical, and economic study: U. S. Bur. of Mines, Bull. 210, p. 26, 1924.

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SILICA (Sand and Quartz).

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 38, 67, 91.

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux, and for steel-casting molds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water glass'). Manufacturers of paint use finely ground silica, which forms as much as one-third of the total pigment in some paints. For certain purposes finely-ground crystalline material is superior in paints to other materials because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear afford a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. It is also preferable for soaps and polishing powders. Part of the 1925 output was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California in 1925 amounted to 12,498 tons valued at $96,780, from thirteen properties in seven counties.

Of the above total 2,334 tons was of sand, and 10,164 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used as yet owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin, and Tulare, the chief centers being Amador, Monterey, and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

Belgium sand is also displacing local material in the manufacture of sodium silicate ('water glass'), having caused the closing down of operations in 1923 of the sand plant of the Philadelphia Quartz Company in Amador County.

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Total Silica Production of California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1913	18,618	$21,899
1900	2,200	2,200	1914	28,538	22,688
1901	5,000	16,250	1915	28,964	34,322
1902	4,500	12,225	1916	20,880	48,908
1903	7,725	7,525	1917	19,376	41,166
1904	10,004	12,276	1918	23,257	88,930
1905	9,257	8,121	1919	18,659	101,600
1906	9,750	13,375	1920	25,324	96,793
1907	11,065	8,178	1921	10,569	49,179
1908	9,255	22,045	1922	9,874	31,016
1909	12,259	25,517	1923	7,964	30,420
1910	19,224	18,265	1924	6,808	35,006
1911	8,620	8,672	1925	12,498	96,780
1912	13,075	15,404	Totals	356,203	$872,260

SILLIMANITE—ANDALUSITE—CYANITE GROUP.

Bibliography: State Mineralogist Report XX. Bulletins 67, 91. Dana's Mineralogy. U. S. Geol. Surv., Prof. Paper 110. Eng. & Min. Jour.-Press, Vol. 120, pp. 91–94, 1925. Amer. Mineralogist, June, 1924.

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteristics. Though both crystallize in the orthorhombic system, their crystal habits are different: Andalusite being usually in coarse prismatic forms, the prisms nearly square in shape; also occurs massive, imperfectly columnar, and sometimes radiated and granular. Sillimanite commonly occurs in long, slender crystals, not distinctly terminated; prismatic faces striated and rounded; often in close parallel groups, passing into fibrous and columnar massive forms, sometimes radiating. Colors are similar. Hardness, andalusite 7.5, sillimanite 6–7. Andalusite is slightly lighter in specific gravity.

A massive deposit of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Porcelain Company of Detroit, Michigan. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs and for other high-tension electric insulators.

Cyanite is also an aluminum silicate (Al_2SiO_5), of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system. Occurs usually in long-bladed crystals, rarely terminated; hardness 5-7.25; gravity 3.56-3.67 (being heavier than the other two); color, blue. A deposit of cyanite, apparently in quantity, is now being developed in Imperial County, near Ogilby, and small shipments have been made for experimental purposes.

Dumortierite, though differing somewhat in composition from the above, being a basic aluminum silicate ($4\ Al_2O_3.3\ SiO_2$), has proved similar in behavior in ceramic work so that it is now being mixed with andalusite for electrical porcelains. A deposit of this mineral in

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Nevada is being mined for that purpose. Occurrences of massive dumortierite are known in Imperial County in this state and there may yet be some commercial possibilities for them.

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII–XXII. Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California in 1925 amounted to 15,465 tons valued at $239,084, compared with 16,179 tons valued at $242,770 in 1924. Nearly eighty per cent of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and some in ceramics. The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of masssive sopastone from Virginia.

Composition and Varieties.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone and steatite. The term 'talc' properly includes all forms of the pure mineral, whereas 'steatite' denotes particularly the massive, compact variety, and 'soapstone' the impure, massive forms containing as low as 50% of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness up to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Uses.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitutes can be used, there are several which are of great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, 'slip,' and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks

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and baked, forming the material used for gas tips and electrical insulation, commonly known as 'lava.' Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. 'French chalk' or 'tailor's chalk' is a soft, massive talc. In China, Japan and India, massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is cut into slabs of 1 to 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones, or fabricated into laundry sinks and tubs, laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids, and alkalies, and electricity are essential.

A detailed description of the classification and uses of talc and soapstone was given in the statistical report for 1922 (Bulletin 93) issued by the State Mining Bureau, copies of which are still available for distribution.

Imports.

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers. In 1925 importations totaled 20,990 short tons valued at $449,338, compared with 18,199 tons valued at $356,629 in 1924, according to the United States Bureau of Foreign and Domestic Commerce.

Talc Production of California, by Years.

Production has been intermittent in the state since 1893, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1910	740	$7,260
1894			1911		
1895	25	375	1912	1,750	7,350
1896			1913	1,350	6,150
1897			1914	1,000	4,500
1898			1915	1,663	14,750
1899			1916	1,703	9,831
1900			1917	5,267	45,279
1901	10	119	1918	11,760	85,534
1902	14	288	1919	8,764	115,091
1903	219	10,124	1920	11,327	221,362
1904	228	2,315	1921	8,752	130,078
1905	300	3,000	1922	13,378	197,186
1906			1923	17,439	252,661
1907			1924	16,179	242,770
1908	3	48	1925	15,465	239,084
1909	33	280	Totals	117,769	$1,613,185

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STRONTIUM.

Bibliography: Bulletins 67, 91. U. S. G. S., Bull. 540; 660-I.

There has been no production of strontium minerals in California since 1918, though in that year both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the only considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite, near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped.

Production of strontium minerals in California, by years, has been as follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,000
1918	2,900	33,000
1919	----------	----------
Totals	6,007	$72,850

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. Previous to 1914, the nitrate was imported from Germany, England, and Sicily. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67, 91.

In 1923-1924 there was a small production of sulphur, from a single property in Kern County. It was ground, and utilized as a fertilizer and in dusting for mildew. This is the first commercial output of native sulphur in California for many years although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura counties.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865-1868 (inc.), totaling 941 tons, valued at

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$53,500; following which the property became more valuable for its quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that the three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons. The mines at Freeport, Texas, are in a peculiarly favorable location in that they are practically at tidewater.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1925, a total of 629,401 long tons valued at $11,000,235 was exported from the United States, principally to Europe and Canada.

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CHAPTER SIX.

SALINES.

Bibliography: State Mineralogist Reports III, XIV, XV, XVII-XXII (inc.). Bulletin 24. Spurr and Wormser, "Marketing of Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, while the nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group shows a slight increase to $4,386,736 in 1925 over the 1924 figure of $4,374,192, as detailed in the following tabulation:

Substance	1924		1925		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borates	52,070	$1,599,149	46,124	$1,526,938	$72,211—
Calcium chloride	*		*		* +
Magnesium salts	4,823	145,883	4,221	132,553	13,330—
Potash	33,107	747,407	36,355	829,770	82,363+
Salt	318,800	1,159,137	284,068	949,826	209,311—
Soda	32,536	711,796	48,625	947,649	235,853+
Unapportioned		a10,820			10,820—
Total value		$4,374,192		$4,386,736	
Net increase					$12,544+

*Under 'Unapportioned.'
a Includes calcium chloride, aluminum sulphate, glauber salt, potash alum.

BORATES.

Bibliography: State Mineralogist Reports III, X, XII-XV (inc.), XVII-XXII (inc.). Bulletins 24, 67, 91.

During 1925 there was produced in California a total of 79,865 tons of borate materials compared with 93,273 tons for the year 1924. The materials shipped in 1925 included crude and selected colemanite ore from Inyo and Kern counties varying from 19% to 30% anhydrous boric acid ('A.B.A.'), also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite

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material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1925 production totals 46,124 tons valued at $1,526,938, a decrease from the similar figures for 1924 which were 52,070 tons and $1,599,149.

Colemanite is a calcium borate, and the material mined is shipped to seaboard chemical plants for refining. Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steelware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats.

Two new uses for borax have been recently reported, which give promise of becoming important factors in the industry. The first is in the preserving of citrus fruits by washing them in a solution of borax, which closes the pores of the skin. The application of this process is increasing in California and Florida. The second is as a preservative of wood, in addition to which borax, being non-inflammable, renders it fireproof.

Surprising as it may seem, the strike in Great Britain in the early months of 1926 had its reaction in places as remote and apparently so dissociated from British economic problems as the region of Death Valley, California. Though popularly known chiefly as a cleansing and preservative commodity, borax has wider and heavier commercial uses in the pottery and metal industries where it is employed as a flux. The suspension of these industries in England, therefore, even for a brief period, affected exports from California's borate mines.

Total Production of Borate Materials in California.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County was discovered in September of the same year by Dr. John A. Veach. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea, to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County. These have since been largely worked out, and the output for a number of years has been coming from similar beds in Inyo and Los Angeles counties. In 1920 San Bernardino County again entered the field with shipments of such ore from near Daggett. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities. Some production of colemanite is being made from deposits recently opened up in Clarke County, Nevada.

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The total production of borate materials in California is shown in the following table:

Year	Tons	Value	Year	Tons	Value
1864	12	$9,478	1895	5,959	$595,900
1865	126	94,099	1896	6,754	675,400
1866	201	132,538	1897	8,000	1,080,000
1867	220	156,137	1898	8,300	1,153,000
1868	32	22,384	1899	20,357	1,139,882
1869			1900	25,837	1,013,251
1870			1901	22,221	982,380
1871			1902	[a]17,202	2,234,994
1872	140	89,600	1903	34,430	661,400
1873	515	255,440	1904	45,647	698,810
1874	915	259,427	1905	46,334	1,019,158
1875	1,168	289,080	1906	58,173	1,182,410
1876	1,437	312,537	1907	53,413	1,200,913
1877	993	193,705	1908	22,200	1,117,000
1878	373	66,257	1909	16,628	1,163,960
1879	364	65,443	1910	16,828	1,177,960
1880	609	149,245	1911	50,945	1,456,672
1881	690	189,750	1912	42,135	1,122,713
1882	732	201,300	1913	58,051	1,491,530
1883	900	265,500	1914	62,500	1,483,500
1884	1,019	198,705	1915	67,004	1,663,521
1885	942	155,430	1916	103,523	2,409,375
1886	1,285	173,475	1917	109,944	2,561,958
1887	1,015	116,689	1918	88,772	1,867,908
1888	1,405	196,636	1919	66,791	1,717,192
1889	965	145,473	1920	127,065	2,794,206
1890	3,201	480,152	1921	50,136	1,096,326
1891	4,267	640,000	1922	[b]39,087	1,068,025
1892	5,525	838,787	1923	62,667	1,893,798
1893	3,955	593,292	1924	52,070	1,599,149
1894	5,770	807,807	1925	46,124	1,526,938
			Totals	1,473,873	$49,947,595

[a]Refined borax. [b]Recalculated to 40% 'anhydrous boric acid' equivalent beginning with 1922.

CALCIUM CHLORIDE.

Bibliography: U. S. Geol. Surv., Min. Res. 1919, Pt. II. Engineering and Contracting, Roads & Streets monthly issue, Feb. 6, 1924. 'How to Maintain Roads,' manual of instruction of Dow Chemical Company.

Calcium chloride is hygroscopic, that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

For dust prevention on roads, it is stated that the flake form of the chloride gives better results than the granulated. Immediately after spreading, the flake begins to absorb moisture from the air—"in fact,

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absorbs three times its weight in water, dissolves itself into the surface material of the road, remains there, holds the moisture and prevents dust.'' It is recommended that the first application in the spring should be made as soon as the roads are partly dried and the spring rains over, in order to prevent the accumulation of the first dust during the season. From 1 to 2 pounds of flake chloride are used per square yard according to the nature of the road surface. Ordinarily a second application, of from ½ to 1 pound per square yard, should follow in from four to six weeks depending upon conditions; and sometimes a light, third application may be necessary during a long, dry summer. The most satisfactory method for applying large quantities of flake calcium chloride is to use an agricultural lime or fertilizer spreader attached by a short tongue to the rear of a truck. Excellent results are reported with the following kinds of road surfaces: gravel, water-bound gravel, water-bound macadam, sand-clay, clay-sand, cinders, mine tailings. It can not be used to advantage on roads of heavy clay, oil-treated surfaces, heavy rolling sand, or the ordinary dirt road which is composed almost entirely of fine dead material. The last named should first have a resurfacing or application of gravel.

A very important and growing use for calcium chloride is its application to curing concrete pavements instead of the slower and more expensive earth and water-covering method. It is stated that one application of the flake chloride will absorb a sufficient amount of moisture from the air to keep the pavements wet continuously 24 hours per day when properly applied. As soon as the newly laid concrete has taken on enough set to permit an application without marring the surface, the chloride should be spread on at the rate of 2 to 2½ pounds per square yard, depending upon the dryness of the weather. It should be evenly spread. There is no need of applying an earth covering and hence no subsequent earth removal, and no extra water pumping, thereby eliminating these items of expense. Not only that, but experience has proved that the time of set for the concrete is shortened by use of the chloride, so that pavements so treated can be opened to traffic in one-half the time required if cured by ponding or by earth and water. In the case of patching broken pavements, if calcium chloride is mixed in with the concrete as laid, in proper proportions, and a further application spread on the finished surface, the patched pavement can be opened to traffic in 48 hours without injury to the concrete.

Californian Production.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes. In 1922–1924, there was only a single operator, so that the annual details are concealed under the 'unapportioned' item.

Year	*Tons*	*Value*
1921	683	$22,980
1922 }	1,204	26,580
1923 } *		
1924 }	10,988	328,876
1925 } *		
Totals	12,875	$378,436

*Annual details concealed under 'Unapportioned.'

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MAGNESIUM SALTS.

Bibliography: State Mineralogist Reports XX, XXI. Bulletin 91. 'Dictionary of Applied Chemistry,' by Thorpe. U. S. Geol. Surv., Min. Res. of U. S.

The production of magnesium chloride and sulphate in California during 1925 totaled 4221 tons valued at $132,553, a slight decrease both in quantity and value from the 1924 figures of 4,823 tons and $145,883. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for 'road liquor.' It was in part marketed in the liquid form testing 34°–36° Baumé, and in part as dry crystals, and was prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo counties. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1925 was approximately $32 per ton, f.o.b. plant.

Total Production of Magnesium Salts in California.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or 'epsom salts' is also made, annually, but in smaller amount.

The total production of magnesium salts in California, since the beginning of the industry here, is shown in the following tabulation:

Year	*Tons*	*Value*
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
1922	3,036	89,788
1923	3,662	116,031
1924	4,823	145,883
1925	4,221	132,553
Totals	27,584	$851,974

NITRATES.

Bibliography: State Mineralogist Report XV. Bulletins 24, 67, 91. U. S. G. S., Press Bulletin No. 373, July, 1918.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

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POTASH.

Bibliography: State Mineralogist Reports XV, XVIII, XX, XXII. Bulletins 24, 67, 91. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789. Eng. & Min. Jour.-Press, Vol. 117, p. 557, Apr. 5, 1924.

During 1925, a total of 36,355 tons of potash salts of all grades was produced in California valued at $829,770, compared with 33,107 tons and $747,407 in 1924. This was entirely of chloride, being mainly from Searles Lake brine, San Bernardino County, but in part from salt-works bitterns at plants in Alameda and San Mateo counties. The quality of the product varied from 45% to 61% equivalent K_2O content; and the material was sold principally for fertilizer manufacture.

Imports of crude potash minerals and salts into the United States in 1925, according to the U. S. Bureau of Foreign & Domestic Commerce, amounted to 820,637 long tons, valued at $13,050,908, compared with 632,019 tons and $10,440,244 in 1924. These materials consisted mainly of 'manure salts,' crude chloride (muriate), and sulphate, and kainite, all of which are admitted duty-free.

Quotations have recently ranged from $45 per ton, c.i.f., Atlantic and Gulf ports, for high-grade sulphate (90%–95%), to $34 per ton for muriate (80%–85%), and $18–$20 for manure salts (30%).

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography and medicine.

Total Production of Potash in California.

Potash production began commercially in California in 1914, with a small yield from kelp. Considerable time and money have been spent on research work incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions, and production there has been accomplished on a commercial scale at plants on Searles Lake, San Bernardino County. Some is also made annually from salt-works bitterns, and for a time there was some from Portland cement dust.

The annual amounts and value of these potash materials, since their beginning in California in 1914, are shown by the following table:

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
1922	17,776	584,388
1923	29,597	709,836
1924	33,107	747,407
1925	36,355	829,770
Totals	383,454	$18,844,358

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SALT.

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXI (inc.); Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 669. U. S. Bur. of Mines, Bull. 146.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Mono Lake, Mono County.

Distribution of the 1925 salt production of California, by counties, was as follows:

Salt Production, by Counties, 1925.

County	*Tons*	*Value*
Alameda	180,712	$497,692
Kern	6,890	28,858
San Bernardino	28,319	101,085
San Mateo	31,325	155,925
Los Angeles, Modoc, Mono,[a] Monterey, San Diego*	36,822	166,266
Totals	284,068	$949,826

[a] Medicinal salts. *Combined to conceal output of a single operator in each.

The above returns show a decrease both in tonnage and value from the record figures of 1924, which were 318,800 tons and $1,159,137. Slightly lower market prices prevailed during 1925, as a result of price cutting by one or two of the operators. As in 1924, there were nine plants operating in Alameda County in 1925, but a total of only eleven in the other counties tabulated (a decrease of one).

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1907	88,063	$310,967
1888	30,800	92,400	1908	121,764	281,469
1889	21,000	63,000	1909	155,680	414,708
1890	8,729	57,085	1910	174,920	395,417
1891	20,094	90,303	1911	173,332	324,255
1892	23,570	104,788	1912	185,721	383,370
1893	50,500	213,000	1913	204,407	462,681
1894	49,131	140,087	1914	223,806	583,553
1895	53,031	150,576	1915	169,028	368,737
1896	64,743	153,244	1916	186,148	455,695
1897	67,851	157,520	1917	227,825	584,373
1898	93,421	170,855	1918	212,076	806,328
1899	82,654	149,588	1919	233,994	896,963
1900	89,338	204,754	1920	230,638	972,648
1901	126,218	366,376	1921	197,989	832,702
1902	115,208	205,876	1922	223,238	819,187
1903	102,895	211,365	1923	275,979	1,130,670
1904	95,968	187,300	1924	318,800	1,159,137
1905	77,118	141,925	1925	284,068	949,826
1906	101,650	213,228			
			Totals	5,189,395	$15,317,956

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SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XX; Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 717.

The production of carbonates and sulphate of sodium in California in 1925 included: soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The total amounted to 48,625 tons valued at $947,649, being an increase in both quantity and value compared with the 1924 figures of 32,536 tons and $711,796.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, and chemicals; the salt cake in paper making; and the trona for metallurgical purposes.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1911	9,023	$52,887
1895	1,900	47,500	1912	7,200	37,094
1896	3,000	65,000	1913	1,861	24,936
1897	5,000	110,000	1914	6,522	115,396
1898	7,000	154,000	1915	5,799	83,485
1899	10,000	250,000	1916	10,593	264,825
1900	1,000	50,000	1917	24,505	928,578
1901	8,000	400,000	1918	20,447	855,423
1902	7,000	50,000	1919	21,294	721,958
1903	18,000	27,000	1920	32,407	1,164,898
1904	12,000	18,000	1921	14,828	438,996
1905	15,000	22,500	1922	20,084	573,661
1906	12,000	18,000	1923	34,885	764,284
1907	----------	----------	1924	32,536	711,796
1908	9,600	14,400	1925	48,625	947,649
1909	7,712	11,593			
1910	8,125	11,862	Totals	417,476	$8,355,721

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CHAPTER SEVEN

BY COUNTIES.

Introductory.

The State of California includes a total area of 158,360 square miles, of which 155,980 square miles are of land. The maximum width is 235 miles, the minimum 148 miles, and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1920 census figures show a total population for California of 3,437,709. A January, 1925, estimate based upon average daily attendance in elementary schools places the figure this year at approximately 5,000,000. Minerals of commercial value exist in every county, and during 1925 some active production was reported to the State Mining Bureau from all of the fifty-eight.

Rank of Counties in Mineral Yield, 1925.

Of the first ten counties, in point of total output for 1925, the first four, Los Angeles, Kern, Orange, Ventura, owe their position mainly to petroleum, as do also Fresno (sixth) and Santa Barbara (ninth). Los Angeles, due to its oil, leads all the others, being credited with 44% of the entire state's total for 1925, having passed Kern in 1923, which led for many years. San Bernardino (fifth) owes its place chiefly to cement, silver, potash, borax, mineral water, and tungsten; Riverside (seventh) to cement, stone, brick and tile; Plumas to copper; Shasta to copper, stone, and pyrite; Santa Cruz to cement. Twenty-six counties have each a total in excess of a million dollars for 1925. Cement is an important item in seven of these counties, gold in six, and magnesite in one. In point of variety and diversity, San Bernardino County led all the others in 1925, with a total of 20 different mineral products on its commercial list, followed by Los Angeles with 18; by Kern, San Diego and Riverside with 17 each; Inyo, 15; Shasta, 14; Butte, 12; Calaveras, Orange, Placer, 11 each; Amador, Fresno, Mono, Sacramento, San Mateo, Santa Barbara, Santa Clara, 10 each. The counties with their mineral resources, production for 1925, etc., are considered in detail in the following paragraphs.

County.	*Value.*	*County.*	*Value.*
1. Los Angeles	$193,180,000	31. Placer	$550,413
2. Kern	89,400,726	32. Butte	546,178
3. Orange	49,104,490	33. Trinity	502,289
4. Ventura	17,853,540	34. Marin	434,802
5. San Bernardino	14,179,663	35. Tulare	426,979
6. Fresno	9,264,996	36. Stanislaus	415,466
7. Riverside	5,179,108	37. El Dorado	352,828
8. Plumas	4,401,508	38. Imperial	330,965
9. Santa Barbara	4,338,431	39. Monterey	277,721
10. Shasta	4,300,449	40. Del Norte	270,582
11. Santa Cruz	3,227,036	41. Napa	229,172
12. Alameda	2,916,506	42. Siskiyou	219,626
13. Yuba	2,721,594	43. Mono	184,745
14. Solano	2,678,547	44. Sonoma	160,231
15. Amador	2,625,703	45. San Luis Obispo	136,477
16. San Benito	2,617,396	46. San Francisco	131,158
17. Inyo	2,585,145	47. Colusa	103,230
18. Contra Costa	2,544,179	48. Glenn	92,288
19. Sacramento	2,504,405	49. Merced	80,262
20. Nevada	2,352,877	50. Tehama	77,183
21. San Mateo	1,577,513	51. Lake	73,348
22. Calaveras	1,450,618	52. Yolo	23,060
23. Sierra	1,386,301	53. Mendocino	16,533
24. Madera	1,377,458	54. Lassen	2,404
25. Santa Clara	1,320,858	55. Modoc	2,400
26. San Diego	1,129,757	56. Alpine	520
27. San Joaquin	737,818	57. Kings	520
28. Humboldt	719,151	58. Sutter	397
29. Mariposa	634,862		
30. Tuolumne	567,248	Total value	$434,519,660

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ALAMEDA.

Area: 843 square miles.
Population: 344,177 (1920 census).
Location: East side of San Francisco Bay.

Alameda County, while in no sense one of the 'mining counties,' comes twelfth on the list with a value of mineral products for 1925 of $2,916,506, an increase over the 1924 total, which was $2,634,645. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, potash, pyrite, salt, soapstone, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$938,375
Clay (pottery)	9,300 tons	11,376
Salt	180,712 tons	497,692
Stone, miscellaneous	------	1,414,398
Other minerals*	------	54,665
Total value		$2,916,506

*Includes magnesium salts, potash, pyrites.

ALPINE.

Area: 776 square miles.
Population: 243 (1920 census).
Location: On eastern border of state, south of Lake Tahoe.

Alpine has at times in the past shown a small production mainly of gold and silver. For 1925 the total value was $520 and included gold, silver, and miscellaneous stone.

This county lies just south of Lake Tahoe, in the high Sierra Nevada. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

AMADOR.

Area: 601 square miles.
Population: 7793 (1920 census).
Location: East-central part of state—Mother Lode district.

The value of Amador County's mineral production decreased from $2,938,865 in 1924 to $2,625,703, placing it number fifteen on the list of counties in the state as regards total value of mineral substances marketed. The decrease was due mainly to gold.

Although having an output consisting of 10 different minerals, the leading product, gold, makes up approximately 89% of the entire total.

Amador at one time led the state in gold production, though exceeded in 1920–1923 by Yuba and Nevada counties, but in 1925 by Yuba County only.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, limestone, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

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Commercial production for 1925 was as follows:

Substance.	*Amount.*	*Value.*
Clay (pottery)	63,889 tons	$95,946
Gold	-----	2,338,101
Silver	-----	16,123
Stone, miscellaneous	-----	31,100
Other minerals*	-----	11,003
Total value		$2,625,703

*Includes coal, copper, lead, marble.

BUTTE.

Area: 1722 square miles.
Population: 30,030 (1920 census).
Location: North-central portion of state.

Butte, thirty-second county in California in regard to the value of its mineral output, reported a commercial production of twelve mineral substances, having a total value of $546,178 as compared with $641,750 in 1924. As will be noted in the following tabulation, gold is by far the most important item. Butte stands seventh among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver, and miscellaneous stone.

Commercial value for 1925 was as follows:

Substance.	*Amount.*	*Value.*
Gold	----	$355,289
Mineral water	4,484 gals.	2,742
Platinum	56 fine oz.	9,177
Silver	----	4,354
Stone, miscellaneous	----	156,738
Other minerals*	----	17,878
Total value		$546,178

*Includes brick, copper, gems (diamonds), lead, natural gas, soapstone.

CALAVERAS.

Area: 1027 square miles.
Population: 6183 (1920 census).
Location: East-central portion of state—Mother Lode district.

Calaveras County reported production of 11 different minerals, valued at $1,450,618 during the year 1925 as compared with the 1924 output of $1,572,419. Copper, gold and stone are the chief mineral substances. For the current year 1926, cement has been added, as the new plant of the Calaveras Cement Company, near San Andreas is now in operation. In regard to total value of mineral output, Calaveras stands twenty-second among the counties of the state, for 1925, and fifth in gold.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble, mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1925 was as follows:

Substance.	*Amount.*	*Value.*
Copper	4,906,650 lbs.	$696,744
Gold	--------	652,433
Silver	--------	8,324
Stone, miscellaneous	--------	78,506
Other minerals*	--------	14,611
Total value		$1,450,618

*Includes pottery clay, gems (quartz crystals), lead, mineral water, platinum.

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COLUSA.

Area: 1140 square miles.
Population: 9920 (1920 census).
Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1925 production was $103,230, an increase over 1924 figures of $77,267, giving it forty-seventh place, and was as follows:

Substance.	*Value.*
Unapportioned*	$103,230

*Includes mineral water, sandstone, miscellaneous stone.

CONTRA COSTA.

Area: 714 square miles.
Population: 53,889 (1920 census).
Location: East side of San Francisco Bay.

Contra Costa, like Alameda County, lies on the eastern shores of San Francisco Bay, and is not commonly considered among the mineral producing counties of the state. It stands eighteenth on the list in this respect, however, with an output valued at $2,544,179 for the calendar year 1925. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1925 was as follows:

Substance.	*Value.*
Stone, miscellaneous	$708,159
Other minerals*	1,836,020
Total value	$2,544,179

*Includes clay (pottery) and clay products, cement, limestone, mineral water.

DEL NORTE.

Area: 1024 square miles.
Population: 2759 (1920 census).
Location: Extreme northwest corner of state.
Transportation: Motor, wagon and mule back; steamer from Crescent City.

Del Norte almost rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone.

The 1925 output was a decrease from the figure of $722,265 in 1924, the principal item of which is crushed rock used on highway construction, and rock used on the Crescent City harbor jetty.

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Commercial production for 1925, giving it fortieth place, was as follows:

Substance	*Value*
Gold	$681
Silver	1
Stone, miscellaneous	269,650
Other minerals	250
Total value	$270,582

EL DORADO.

Area: 1753 square miles.
Population: 6426 (1920 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes thirty-seventh on the list of counties ranked according to the value of their total mineral production during the year 1925. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The decrease from the 1924 figure of $395,572 was due to limestone.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, slate soapstone, silver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$40,212
Limestone	228,293 tons	297,127
Silver	------	238
Stone, miscellaneous	------	10,305
Other minerals*	------	4,946
Total value		$352,828

*Includes lime and silica.

FRESNO.

Area: 5950 square miles.
Population: 128,779 (1920 census).
Location: South-central portion of state.

Fresno County, sixth in importance as a mineral producer among the counties of California, reported an output for 1925 of ten mineral substances, with a total value of $9,264,996, a decrease from the reported 1924 production, which was worth $12,547,798.

The bulk of the above is derived from the petroleum production of the Coalinga field, with miscellaneous stone also important.

The mineral resources of this county are many, and, aside from crude oil, are in the main not fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, mag-

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nesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$25,056
Granite	------	63,580
Natural gas	1,515,889 M cu. ft.	116,711
Petroleum	7,773,665 bbls.	8,503,390
Silver	------	151
Stone, miscellaneous	------	457,307
Other minerals*	------	98,801
Total		$9,264,996

*Includes clay and clay products, mineral water.

GLENN.

Area: 1259 square miles.
Population: 11,853 (1920 census).
Location: West side of Sacramento Valley.

Glenn County, standing forty-eighth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1925 was as follows, being an increase from the $41,550 of the previous year:

Substance	*Value*
Stone, miscellaneous	$92,288

HUMBOLDT.

Area: 3634 square miles.
Population: 37,857 (1920 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Nine mineral substances, as shown by the table given below, having a total value of $719,151, were produced in 1925, as compared with the 1924 output of $485,478, the increase being due to the large amount of rock being used in jetty construction at Humboldt Bay (Eureka Harbor). Humboldt ranks twenty-eighth among the counties of the state for the year.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$13,142
Silver	62
Stone, miscellaneous	699,740
Other minerals*	6,207
Total value	$719,151

*Includes brick, pottery clay, mineral water, natural gas, platinum.

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IMPERIAL.

Area: 4089 square miles.
Population: 43,383 (1920 census).
Location: Extreme southeast corner of the state.

During 1925 Imperial County produced six mineral substances having a total value of $330,965, an increase over the 1924 output of $139,908. Its rank is thirty-eighth. This county contains deposits of cyanite, gold, gypsum, lead, manganese, marble, pumice, salt, silver, sodium, and strontium, largely undeveloped.

Commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$148,942
Other minerals*	182,023
Total value	$330,965

*Includes brick, cyanite, gypsum, pumice.

INYO.

Area: 10,019 square miles.
Population: 7031 (1920 census).
Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1925 reached a value of $2,585,145, standing seventeenth among the counties of the state in this respect. Fifteen different mineral substances were produced. The 1924 value was $2,110,075, the increase being due mainly to lead, soda, and tungsten, in spite of a drop in borates. Its mineral resources include antimony, asbestos, barytes, borates, copper, dolomite, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Copper	73,003 lbs.	$10,367
Gold	------	43,774
Lead	6,307,105 lbs.	548,196
Silver	------	117,763
Talc	5,335 tons	89,134
Zinc	145,000 lbs.	11,020
Other minerals*	------	1,764,891
Total value		$2,585,145

*Includes borates, building stone (tuff), fuller's earth, graphite, limestone, pumice, soda (ash and bicarbonate), tungsten concentrates.

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KERN.

Area: 8003 square miles.
Population: 54,843 (1920 census).
Location: South-central portion of state.

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all counties of California in the value of its mineral output, the exact figures for 1925 being $89,400,726. Kern was surpassed by both Los Angeles and Orange counties in 1923, but by Los Angeles, only, in 1924-1925, for which petroleum is also responsible. The 1924 mineral output for this county was worth $74,164,451. The increase was due to the higher prices for crude oil of all grades. During 1925, seventeen different mineral substances were produced.

Among the mineral resources, developed and undeveloped, of this section are antimony, asphalt, borax, brick, clay, copper, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, salt, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$135,545
Natural gas	45,649,845 M cu. ft.	2,290,608
Petroleum	58,852,742 bbls.	84,255,094
Salt	6,890 tons	28,858
Silver	------	7,455
Stone, miscellaneous	------	3,000
Other minerals*	------	2,680,166
Total value		$89,400,726

*Includes antimony, borates, brick and clay.

KINGS.

Area: 1559 square miles.
Population: 22,031 (1920 census).
Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Some drilling for oil has been under way, but there has, as yet, been no commercial output recorded.

Tulare Lake is in Kings County, though now largely drained, and the land under cultivation.

In a tie for fifty-sixth place with Alpine County, commercial mineral production in this county for 1925 was as follows:

Substance	*Amount*	*Value*
Natural gas	740 M cu. ft.	$440
Other minerals	---	80
Total value		$520

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LAKE.

Area: 1278 square miles.
Population: 5542 (1920 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

In fifty-first place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Mineral water	62,970 gals.	$57,793
Stone, miscellaneous	-----	15,300
Other minerals*	-----	255
Total value		$73,348

*Includes copper and natural gas.

LASSEN.

Area: 4531 square miles.
Population: 8507 (1920 census).
Location: Northeast portion of state.

Lassen County is one of the only partly developed sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been produced, but not for some years, until 1921, when the yield again became important. In fifty-fourth place, commercial production for 1925 was as follows:

Substance	*Value*
Gold	$1,130
Silver	24
Stone, miscellaneous	1,250
Total value	$2,404

LOS ANGELES.

Area: 4067 square miles.
Population: 936,438 (1920 census).
Location: One of the southwestern coast counties.

Mineral production in Los Angeles County for the year 1925 amounted in value to $193,180,000 as compared with the 1924 output, worth $168,420,709. This accounts for 44% of the entire state's total for 1925, and ranks Los Angeles County first in the state as a mineral producer, having in 1924 passed Kern County which had been leading for several years. The advance in 1925 was due to higher petroleum prices, in spite of decreases by brick and natural gas.

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Its output of brick and tile was over three million dollars, and that of petroleum amounted to over one hundred and seventy-three million dollars. Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1925, consisting of 18 substances, was as follows:

Substance	*Amount*		*Value*
Brick	196,955	M	$3,300,748
Building tile (hollow)	44,345	tons	426,178
Clay (pottery)	217,707	tons	106,817
Gold	------		409
Mineral water	3,811,270	gals.	336,038
Natural gas	98,226,700	M cu. ft.	8,704,894
Petroleum	121,214,551	bbls.	173,215,593
Silver	------		15,444
Stone, miscellaneous	------		6,978,605
Other minerals*	------		95,274
Total value			$193,180,000

*Includes copper, lead, limestone, magnesium chloride, salt, sandstone, zinc.

MADERA.

Area: 2112 square miles.
Population: 12,203 (1920 census).
Location: East-central portion of state.

Madera County produced five different mineral substances during the year 1925, having a total value of $1,377,458, as compared with the 1924 output worth $955,469, the increase being due to granite. This county contains deposits of copper, gold, granite, iron, lead, molybdenum, pumice, silver, and building stone.

In twenty-fourth place, commercial production for 1925 was as follows:

Substance	*Value*
Gold	$2,366
Granite	1,358,410
Silver	82
Stone, miscellaneous	16,600
Total value	$1,377,458

MARIN.

Area: 529 square miles.
Population: 27,342 (1920 census).
Location: Adjoins San Francisco on the north.

Mineral production in Marin County during 1925 amounted to $434,802, being a decrease from the 1924 figure of $527,231 due to crushed rock. This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In thirty-fourth place, commercial production for 1925 was:

Substance	*Value*
Stone, miscellaneous	$244,602
Other minerals*	190,200
Total value	$434,802

*Includes brick, pottery clay, mineral water.

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MARIPOSA.

Area: 1463 square miles.
Population: 2775 (1920 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but twenty-ninth on the list of counties in regard to the value of its mineral output for 1925 with a total of $634,862, as compared with the 1924 figure of $234,707, the increase being due to stone and gold.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$192,910
Silver	1,758
Stone, miscellaneous	436,794
Other minerals	3,500
Total value	$634,862

MENDOCINO.

Area: 3453 square miles.
Population: 24,116 (1920 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production has usually been small, the 1925 output being valued at $16,533, ranking it fifty-third among the counties. That of 1924 was worth $60,768.

Deposits of in part undetermined value of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold, platinum, and silver.

Commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$11,603
Other minerals*	4,930
Total value	$16,533

*Includes brick, coal, natural gas.

MERCED.

Area: 1995 square miles.
Population: 24,579 (1920 census).
Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley and it figures as one of the lesser mineral producing counties of the state. The 1925 mineral output was valued at $80,262 compared with $87,603 in 1924, the decrease being due to clay products.

Gold, platinum, and silver were formerly obtained in important amounts by dredging, which ceased in this county in 1918, though a small yield from other sources still continues. Undeveloped deposits

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of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In forty-ninth place, commercial production during 1925 was as follows:

Substance	*Value*
Clay and clay products	$43,326
Gold	289
Silver	1
Stone, miscellaneous	36,646
Total value	$80,262

MODOC.

Area: 3823 square miles.
Population: 5425 (1920 census).
Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are clay, coal, gold, iron, quicksilver, salt, and silver. In fifty-sixth place, commercial production for 1925 was as follows:

Substance	*Value*
Unapportioned*	$2,400

*Includes salt and miscellaneous stone.

MONO.

Area: 3030 square miles.
Population: 960 (1920 census).
Location: Is bordered by the State of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a somewhat inaccessible country so far as rail transportation is concerned. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-third place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Copper	1,020 lbs.	$145
Gold	------	5,503
Lead	22,488 lbs.	1,957
Silver	------	1,590
Stone, miscellaneous	------	29,250
Other minerals*	------	146,300
Total value		$184,745

*Includes onyx, pumice, travertine, salt, silica (stucco-sand) sillimanite-andalusite.

MONTEREY.

Area: 3330 square miles.
Population: 27,980 (1920 census).
Location: West-central portion of state, bordering on Pacific Ocean.

Monterey County produced nine mineral substances during the year 1925, having a total value of $277,721, as compared with the 1924 output worth $286,490, the decrease being due to miscellaneous stone. Its mineral resources include brick, clay, copper, coal, diatomaceous earth,

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dolomite, feldspar, fuller's earth, gold, gypsum, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In thirty-ninth place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Clay (pottery)	414 tons	$1,161
Gold	----	998
Silver	----	3
Stone, miscellaneous	----	209,423
Other minerals*	----	66,136
Total value		$277,721

*Includes diatomaceous earth, quicksilver, salt, shale building stone, silica (glass sand).

NAPA.

Area: 783 square miles.
Population: 20,678 (1920 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties.'

Napa, because of its production of structural and industrial materials and mineral water, stands forty-first on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, gypsum, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone. In the past this county has been one of the important producers of quicksilver.

In 1925 the value of the output decreased to $229,172 from the 1924 figure of $359,265.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	----	$195
Mineral water	63,836 gals.	44,251
Silver	----	1,420
Stone, miscellaneous	----	177,186
Other minerals	----	6,120
Total value		$229,172

NEVADA.

Area: 974 square miles.
Population: 10,860 (1920 census).
Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921, also 1923. In 1922 and 1924, Nevada led, but dropped to third place in 1925. Nevada County stands twentieth on the list in regard to value of its total mineral output with a figure of $2,352,877 as compared with the 1924 production worth $2,945,267. The decrease is due to gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, bismuth, chromite, clay, copper, gems, iron, lead, mineral paint, pyrite, soapstone, and tungsten.

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Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$2,305,607
Silver	32,155
Stone, miscellaneous	10,333
Other minerals*	4,782
Total value	$2,352,877

*Includes chromite, copper, granite, lead.

ORANGE.

Area: 795 square miles.
Population: 61,375 (1920 census).
Location: Southwestern portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral producing section. It stood for several years, however, as the second county in the state in regard to the total value of mineral output, on account of its highly productive oil fields. It was passed in 1922 by Los Angeles, the credit for which is also due to oil, and in turn Orange passed Kern County in 1923, but dropped back to third in 1924 and 1925.

This county shows an increase in 1925, with a total value of mineral products of $49,104,490, compared to the 1924 output, worth $40,481,210 due to petroleum. Orange passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick	3,253 M	$39,445
Clay (pottery)	13,431 tons	42,562
Gold	------	52
Natural gas	26,324,364 M cu. ft.	2,324,014
Petroleum	32,734,420 bbls.	46,384,673
Silver	------	995
Stone, miscellaneous	------	307,112
Other minerals*	------	5,637
Total value		$49,104,490

*Includes copper, lead, zinc.

PLACER.

Area: 1395 square miles.
Population: 18,584 (1920 census).
Location: Eastern border of state directly west of Lake Tahoe.

While standing only thirty-first on the list of mineral producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products include gold, chromite, granite, copper, and clay. Other mineral resources are asbestos, brick, coal, gems, iron, lead, limestone, magnesite,

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manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1925 was as follows, compared to a total value of $492,180 for the preceding year:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$147,981
Clay (pottery)	102,598 tons	138,813
Gold	------	121,785
Granite	------	14,929
Silver	------	620
Stone, miscellaneous	------	117,990
Other minerals*	------	8,295
Total value		$550,413

*Includes chromite, copper, silica (quartz).

PLUMAS.

Area: 2594 square miles.
Population: 5681 (1920 census).
Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Mineral production for 1925 was valued at $4,406,508, the increase being due to copper and silver. This placed the county eleventh in rank. In 1919 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down, which position Plumas still retains.

Among its mineral resources are chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdemum, platinum, silver, and zinc.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Copper	26,950,029 lbs.	$3,826,904
Gold	--------	249,540
Silver	--------	294,254
Other minerals*	--------	30,810
Total value		$4,401,508

*Includes chromite, granite, manganese ore, miscellaneous stone.

RIVERSIDE.

Area: 7240 square miles.
Population: 60,297 (1920 census).
Location: Southern portion of state.

Riverside is the fourth county in the state in size and the seventh in regard to the total value of mineral output for 1925. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials and salines, some of the more important being brick, cement, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, soapstone, silver, miscellaneous stone and tin. In point of variety, Riverside County showed seventeen different minerals commercially produced in 1925. The increase in 1925 from the 1924 value of $5,508,244 was due to cement.

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Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$533,650
Clay (pottery)	74,787 tons	155,315
Copper	23,134 lbs.	3,285
Feldspar	1,990 tons	16,090
Gold	------	3,687
Granite	------	32,234
Lead	135,872 lbs.	11,821
Silica (quartz)	8,121 tons	84,706
Silver	------	2,570
Stone, miscellaneous	------	542,020
Other minerals*	------	3,793,730
Total value		$5,179,108

*Includes cement, coal, gypsum, mineral water.

SACRAMENTO.

Area: 983 square miles.
Population: 90,978 (1920 census).
Location: North-central portion of state.

Sacramento stands nineteenth among the counties of the state as a mineral producer, the output, principally gold, for 1925, being valued at $2,504,405, as compared with the 1924 production, worth $2,196,210. In regard to gold output alone, this county ranks fifth, being exceeded only by Yuba, Nevada, Amador and Sierra counties, the Sacramento product coming from the dredges. Its mineral resources include brick, clay, gold, granite, natural gas, platinum, silver, and miscellaneous stone.

Substance	*Value*
Brick and hollow building tile	$354,078
Clay (pottery)	2,748
Gold	1,302,320
Granite	155,250
Silver	1,920
Stone, miscellaneous	590,359
Other minerals*	97,730
Total value	$2,504,405

*Includes natural gas and platinum.

SAN BENITO.

Area: 1392 square miles.
Population: 8995 (1920 census).
Location: West-central portion of state.

While sixteenth among the counties of the state in regard to value of total mineral production for 1925, San Benito has led for some years in one important branch of the mineral industry, namely, quicksilver. Cement is also an important item.

Its other mineral resources, many of them undeveloped, include antimony, asbestos, bituminous rock, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Quicksilver	6,085 flasks	$486,797
Stone, miscellaneous	------	351,363
Other minerals*	------	1,779,236
Total value		$2,617,396

*Includes asbestos, cement, dolomite, magnesite, mineral water.

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SAN BERNARDINO.

Area: 20,157 square miles.
Population: 73,401 (1920 census).
Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state in area, ranks fifth as regards the value of its mineral output for 1925 with a total of $14,179,663, as compared with the 1924 total of $12,642,431. The increase is due mainly to cement, but in part to borates, mineral water, and potash.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1925 a total of 20 different substances. This county also ranks first as a silver producer in the state, from the mines of the Randsburg district. In fact, the California Rand mine, there, has been the largest single producer in the United States for several years past.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Cement	5,079,281 bbls.	$8,828,044
Clay (pottery)	1,540 tons	11,000
Copper	6,249 lbs.	888
Gold	------	157,374
Lead	61,480 lbs.	5,349
Lime	17,495 tons	124,446
Limestone	13,239 tons	27,569
Salt	28,319 tons	101,085
Silver	------	1,378,392
Stone, miscellaneous	------	395,048
Other minerals*	------	3,150,468
Total value		$14,179,663

*Includes borates, calcium chloride, fuller's earth, mineral water, petroleum, potash, soda (trona), talc, tungsten concentrates.

SAN DIEGO.

Area: 4221 square miles.
Population: 112,248 (1920 census).
Location: Extreme southwest corner of state.

San Diego ranks twenty-sixth in the total value of its mineral output for the year, with 17 different commercial minerals. The value for 1925 equaled $1,129,757, as compared with the 1924 output worth $1,013,119.

In the production of gems, San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

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Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$119,165
Gems	------	9,413
Clay (pottery)	26,976 tons	66,427
Gold	------	5,134
Granite	------	108,703
Mineral water	81,374 gals.	21,137
Silver	------	58
Stone, miscellaneous	------	508,538
Other minerals*	------	291,182
Total value		$1,129,757

*Includes feldspar, fuller's earth, lime, magnesium chloride, salt, silica.

SAN FRANCISCO.

Area: 43 square miles.
Population: 506,676 (1920 census).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting mainly of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In forty-sixth place, commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$131,158

SAN JOAQUIN.

Area: 1448 square miles.
Population: 79,905 (1920 census).
Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1925 having a total value of $737,818, as compared with the 1924 output worth $602,500.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum, and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In twenty-ninth place, commercial production for 1925 was as follows:

Substance	*Value*
Brick and hollow building tile	$472,983
Stone, miscellaneous	103,237
Other minerals	161,598
Total value	$737,818

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SAN LUIS OBISPO.

Area: 3334 square miles.
Population: 21,893 (1920 census).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1925 was $136,477, as compared with the 1924 output, worth $317,779, the decrease being due to miscellaneous stone and sodium sulphate. Among its mineral resources, both developed and undeveloped, are asphalt, bituminous rock, brick, chromite, coal, copper, diatomaceous earth, gypsum, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda, and miscellaneous stone.

In thirty-eighth place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$840
Petroleum	29,590 bbls.	32,164
Silver	------	7
Stone, miscellaneous	------	50,113
Other minerals*	------	53,353
Total values		$136,477

*Includes brick, chromite, mineral water, natural gas, quicksilver, sodium sulphate.

SAN MATEO.

Area: 447 square miles.
Population: 36,781 (1920 census).
Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are stone and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1925 equaled $1,577,513, as compared with the 1924 figures of $302,171, the increase being due to the starting of operations by the new cement plant of the Pacific Portland Cement Company at Redwood City.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below. Bricks have also been produced commercially.

In twenty-first place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Salt	31,325 tons	$155,925
Stone, miscellaneous	------	90,757
Other minerals*	------	1,330,831
Total value		$1,577,513

*Includes cement, gems (jasper), magnesium chloride, natural gas, petroleum, potash.

SANTA BARBARA.

Area: 2740 square miles.
Population: 41,097 (1920 census).
Location: Southwestern portion of state, adjoining San Luis Obispo on the south.

Santa Barbara County owes its position of ninth in the state in regard to its mineral output to the presence of productive oil fields

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within its boundaries. The total value of its mineral production during the year 1925 was $4,338,431, as compared with the 1924 output of $5,159,740, and included ten different mineral substances.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, diatomaceous earth, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick	4,205 M	$56,781
Hollow building tile	1,864 tons	18,706
Clay (pottery)	2,390 tons	5,800
Natural gas	2,545,208 M cu. ft.	248,708
Petroleum	2,647,380 bbls.	2,419,705
Stone, miscellaneous	------	106,665
Other minerals*	------	1,482,066
Total value		$4,338,431

*Includes diatomaceous earth, mineral water, shale oil.

SANTA CLARA.

Area: 1328 square miles.
Population: 100,588 (1920 census).
Location: West-central portion of state.

Santa Clara County reported a mineral output for 1925 of $1,320,858, as compared with the 1924 figures of $1,150,401.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone.

In twenty-fifth place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick	24,250 M	$251,059
Clay (pottery)	1,516 tons	3,216
Petroleum	13,828 bbls.	22,594
Stone, miscellaneous	------	453,273
Other minerals*	------	590,718
Total value		$1,320,858

*Including limestone, magnesite, mineral water, natural gas, quicksilver.

SANTA CRUZ.

Area: 435 square miles.
Population: 26,269 (1920 census).
Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $3,227,036, giving the county a standing of eleventh among all others in the state in this regard.

The decrease from the 1924 figure of $4,339,233 is due to cement.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Lime	16,534 tons	$224,724
Limestone	16,551 tons	33,102
Stone, miscellaneous	------	21,125
Other minerals*	------	2,948,085
Total value		$3,227,036

*Includes bituminous rock and cement.

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SHASTA.

Area: 3858 square miles.
Population: 13,311 (1920 census).
Location: North-central portion of state.

Shasta County stood tenth in California among the mineral producing counties for 1925, with an output valued at $4,300,449, as compared with the 1924 production worth $4,754,664, the decrease being due to copper, and in part to gold and stone, though zinc advanced.

The marked decrease since 1918 is due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin; but in 1919-1923 was passed by San Bernardino, Plumas, Yuba, Inyo, Sacramento, Nevada, and Amador, among the 'metal' counties, though by only San Bernardino and Plumas of that group in 1925.

Shasta's mineral resources include asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrite, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1924 was as follows:

Substance	*Amount*	*Value*
Copper	14,565,967 lbs.	$2,068,367
Gold	------	235,013
Lead	647,886 lbs.	56,366
Limestone	24,395 tons	28,480
Platinum	8 fine oz.	725
Silver	------	208,818
Stone, miscellaneous	------	349,617
Zinc	11,090,430 lbs.	842,873
Other minerals*	------	510,190
Total value		$4,300,449

*Includes chromite, diatomaceous earth, iron ore, pyrites, talc.

SIERRA.

Area: 923 square miles.
Population: 1783 (1920 census).
Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $1,386,301, mainly of gold and silver, during the year 1925, as compared with the 1924 output worth $812,476, the increase being due to gold. Considering gold output alone this county stands fourth; and as to total mineral yield twenty-third.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, serpentine, and talc.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$1,373,705
Silver	8,919
Stone, miscellaneous	3,677
Total value	$1,386,301

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SISKIYOU.

Area: 6256 square miles.
Population: 18,545 (1920 census).
Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks forty-fourth in regard to the value of its mineral output for 1924.

Although this county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable degree.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$180,120
Lime and limestone	3,535
Silver	831
Stone, miscellaneous	23,800
Other minerals*	11,340
Total value	$219,626

*Includes mineral water, platinum, sandstone.

SOLANO.

Area: 822 square miles.
Population: 40,602 (1920 census).
Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1925 to the total value of $2,678,547, ranking fourteenth among the counties of the state, the decrease from the 1924 figures of $3,089,475 being due to cement.

Among her mineral resources are brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$145,484
Other minerals*	2,533,063
Total value	$2,678,547

*Includes cement, mineral water, onyx, travertine.

SONOMA.

Area: 1577 square miles:
Population: 51,990 (1920 census).
Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked forty-fourth among the counties of California during the year 1925, with a mineral production of $160,231, as compared with

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its 1924 output of $172,051. More paving blocks have been turned out here than in any other section of the state, but this industry has now ceased, owing to the construction of smooth-surface pavements both in the cities and on the highways.

Among Sonoma's mineral resources are brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Mineral water	19,963 gals.	$6,619
Quicksilver	351 flasks	29,134
Stone, miscellaneous	------	119,546
Other minerals*	------	2,200
Total value		$160,231

*Includes pottery clay, building stone (tuff), manganese ore.

STANISLAUS.

Area: 1450 square miles.
Population: 43,557 (1920 census).
Location: Center of state, bounded on south by Merced County.

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921–1923 and 1925, by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1925 ranks thirty-sixth in the state in regard to value of minerals, with an output of $415,466, as compared with $345,138 in 1924, the increase being due to miscellaneous stone, though there was a decrease in gold yield. Gold, platinum, and silver are obtained mainly by dredging.

Commercial production for 1924 was as follows:

Substance	*Value*
Gold	$171,742
Silver	694
Stone, miscellaneous	221,256
Other minerals*	21,774
Total value	$415,466

*Includes magnesite, manganese ore, mineral paint, platinum.

SUTTER.

Area: 608 square miles.
Population: 10,115 (1920 census).
Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, also in 1925. There has been some utilization of natural gas. The 1925 mineral yield was valued at $397, being concealed under 'unapportioned.' Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

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TEHAMA.

Area: 2893 square miles.
Population: 12,882 (1920 census).
Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands fiftieth among the mineral producing counties of the state for 1925 when its output was valued at $77,183, as compared with the 1924 yield worth $34,454, the increase being due to stone.

Among its mineral resources are listed brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1925 yield was distributed as follows:

Substance	*Value*
Unapportioned*	$77,183

*Includes brick and miscellaneous stone.

TRINITY.

Area: 3166 square miles.
Population: 2551 (1920 census).
Location: Northwestern portion of state.

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver, and platinum, very little active production of these mineral substances has been made as yet. The 1925 output of $502,289 shows a decrease from the 1924 figure of $509,344, due to copper, giving the county rank of thirty-third for the year.

Substance	*Amount*	*Value*
Copper	439,766 lbs.	$62,447
Gold	------	424,037
Platinum	26 fine oz.	3,081
Silver	------	7,724
Stone, miscellaneous	------	5,000
Total value		$502,289

TULARE.

Area: 4856 square miles.
Population: 59,031 (1920 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands thirty-fifth on the list of mineral producing counties, the decrease from the 1924 value being due mainly to magnesite.

This county's mineral resources, among others, are brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, except in 1918 when it was passed by Napa County, and in 1921-1925 by Santa Clara.

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Commercial production for 1925 was as follows:

Substance	Amount	Value
Granite	------	$62,260
Limestone	13,300 tons	43,900
Magnesite	18,150 tons	245,557
Natural gas	280 M cu. ft.	175
Stone, miscellaneous	-------	47,176
Other minerals*	-------	27,911
Total value		$426,979

*Includes brick and lime.

TUOLUMNE.

Area: 2190 square miles.
Population: 7768 (1920 census).
Location: East-central portion of state—Mother Lode District.

Tuolumne ranks thirtieth among counties of the state relative to its total value of mineral output for 1925. This county ranks first as a producer of marble in the state. The decrease in the year's valuation to $567,248 for 1925 from the 1924 figure of $629,156 was due mainly to gold.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1925 was as follows:

Substance	Value
Gold	$155,592
Lime and limestone	268,000
Silver	614
Stone, miscellaneous	29,751
Other minerals	113,305
Total value	$567,248

*Includes dolomite, granite, marble.

VENTURA.

Area: 1878 square miles.
Population: 28,724 (1920 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the fourth county in the state in respect to the value of its mineral production for 1925, the exact figure being $17,853,540, as compared with the output for 1924 worth $6,089,394, the increase being due to petroleum and natural gas.

The highest gravity petroleum produced in the state is found here.

Among its other mineral resources are asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	Amount	Value
Natural gas	20,144,646 M cu. ft.	$1,953,163
Petroleum	9,221,846 bbls.	15,769,357
Stone, miscellaneous	-------	131,020
Total value		$17,853,540

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YOLO.

Area: 1014 square miles.
Population: 17,105 (1920 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1925 consisted entirely of miscellaneous stone, valued at $23,060, ranking it in fifty-second place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA.

Area: 639 square miles.
Population: 10,375 (1920 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas:

Yuba is thirteenth of the mineral producing counties of the state, and first in regard to gold output for 1925, having passed Nevada and Amador counties in that metal. Iron and clay deposits have been reported in this county aside from the following commercial production shown for the year 1925. The increase over the 1924 figure of $2,190,181 was due mainly to gold obtained by the dredgers, which also yield silver and platinum. The 1921 dredge yield of gold was a record for the county.

The 1925 production of Yuba County was distributed as follows:

Substance	*Value*
Gold	$2,570,630
Silver	6,400
Stone, miscellaneous	137,288
Other minerals*	7,276
Total value	$2,721,594

*Includes natural gas and platinum.

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APPENDIX.

MINING BUREAU ACT.

Chapter 679.

[Stats. 1913.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the State of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau. and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information available to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

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SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirtieth day of June, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devises and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state mineralogist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau and to exchange publications with other geological surveys and scientific societies, etc.

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*Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

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SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

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PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

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**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

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Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
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**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp. ----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp. ----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp. ---------- Free
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper ---------- Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper ---------- Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper ----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper ----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper ----

MISCELLANEOUS PUBLICATIONS.

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**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp. ----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp. ----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp. ----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp. ----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp. ----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp. ----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894 ----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper ----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper ---------- Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923 ---------- Free

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MAPS.

Registers of Mines With Maps.

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	Price
**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	.25
Register of Oil Wells, with Map, Los Angeles City	.35

OTHER MAPS.

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**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

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OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

	Price
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays. or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package. etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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INDEX.

	Page
Alameda County	129
Alpine County	129
Aluminum	36
Amador County	129
Amblygonite	111
American Bureau of Metal Statistics, Chart	36
American Petroleum Institute, cited	21
Andalusite	115
Antimony	36
native	37
total production	37
Appendix	154
Aquamarine	101
Architectural terra cotta	96
Arrowhead Hot Springs, radioactivity at	110
Arsenic	37
Art pottery	96
Asbestos	91
San Benito Asbestos Co.	91
prices, Canadian asbestos	92
Asphalt	93
Bancroft, H. H., cited	45
Barytes	93
total production	94
Ballast	88
Bauxite	36
Benitoite	100, 101
Bentonite	100
Beryl	38, 101
Beryllium	38
Bismuth	38
Bisque ware	96
Bituminous rock	63
total production	64
Borates	120
production, 1864-1925	122
Bowles, O., cited	82
Bradley, W. W., cited	25
Brown, C. C., cited	17
J. R., cited	42
Brick	64–67
production of various kinds	65
total production, 1893–1925	67
Building stone. (*See* Granite, Marble, Sandstone, etc.)	
Bulletins, list of	159
Bush, R. D., cited	21, 27
Butte County	130
Cadmium	39
Calaveras County	130
Cement Co.	68
Calcium chloride	122
use on roads	123
California, area of	128
map of, showing approximate location of oil fields	27
Zinc Co.	61
Californite	101
Casing-head gas	19
Celestite	96
Cement	67, 96
total production	68
Champion Porcelain Co.	115
Chart, California, showing location of oil fields and districts	27
mineral production, annual value and increase	14
natural gas, casing-head	18
production and utilization	18
non-ferrous metals, current trend of world production	36
prices, asbestos, Canadian	92
copper, electrolytic	40
lead, common	48
silver, bar, bullion	56
zinc, slab	60
Chemical stoneware	96
Chimney pipe	96
Chinaware	96
Chipman Chemical Co., cited	37

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	PAGE
Chromite	68
concentration of	69
imports of	69
occurrence of	69
total production	70
Chrysoprase	102
Clay—pottery	94
production, 1887–1925	96
products	96
uses of, other than for pottery	94
Coal	15
gas from	15
total production of	16
Cobalt	39
Colemanite	121
Collom, R. E., cited	25
Colusa County	131
Concentrating Plant California Zinc Co.	61
Concentration of chromite	69
Concrete	88
Conduit	96
Contra Costa County	131
Copper	40
chart, trend of world production	35
electrolytic copper prices	40
production, 1882–1925	42
stocks of, in United States	42
United States production of	41
'Cornish' or 'Cornwall' stone	95
Cost data on oil operations	32
Counties, mineral production of	128
Crushed rock	62, 86
Cryolite	36
Cyanite	115
Curbing	72
Del Norte County	131
Diamonds	101
Diatomaceous earth	105
Dividends by oil companies	31
Dolomite	96
total production	97
Dolomitic marble	88
Don Manuel Castanares, cited	45
Drain tile	96
Dredge production of platinum	51
Dredging, gold	44
Dumortierite	115
El Dorado County	132
roofing of slate on residence	82
Electric smelting of ferro alloys	47
Eng. and Min. Jour.-Press, cited	40, 56, 60, 100
Faience tile	96
Feldspar	97
total production	98
Ferberite	59
Ferguson blocks	65
Ferro-chrome by electric furnace	47
Ferro-manganese	47
by electric furnace	47
Ferro-tungsten	59
Filter sand	86
Fire brick	65
clay	96
Flue linings	96
Fluorspar	98
Fresno County	132
Fuels	15–33
Fuller's earth	99
total production	100
Garnets	101
Gas (*See* Natural Gas)	
Gasoline from natural gas	19
Gavjn, M. J., cited	113
Gems	100
total production	102
varieties	101
Geysers, California, radioactivity at	110
Glass sand	114
Glenn County	133
Gold	43
production by counties, 1925	44
total production	46
Goodyear, W. A., cited	16

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PAGE

Gould, H., cited ... 54
Granite ... 70
  production, 1887–1925 ... 73
  Rock Co. plant ... 85
  varieties of, in California ... 71
Granules for roofing and stucco ... 88
Graphite ... 102
  total production ... 103
Gravel ... 85
Greenstone granules ... 88
Grinding mill pebbles ... 84
Gypsum ... 103
  deposit, Pacific Portland Cement Co. ... 104
  total production ... 105
  uses ... 105

Hanks, Henry, cited ... 23
High-speed steels ... 59
Hill, J. M., cited ... 44, 52, 56, 74
Hittell, T. H., cited ... 45
Hollow building tile or blocks ... 64
Hübernite ... 58
Humboldt County ... 133
Hyacinth ... 101
Hydrargillite ... 35
Hydrocarbons ... 15

Imperial County ... 134
Industrial materials ... 90–119
Infusorial earth ... 105
  total production ... 106
Inyo County ... 134
Iridium ... 51
Iron ore ... 34, 47
  electric smelting of ... 47
  total production ... 47

Jade ... 101
Jasper ... 101
  roofing granules ... 88
Jewelers' materials (*See* Gems)

Kaolin ... 95
Kern County ... 17, 135
Kieselguhr ... 106
Kings County ... 135
Kunzite ... 101

Lake County ... 136
Lassen County ... 136
Lassen Peak ... 148
Lawver, A. M., cited ... 57
Lead ... 47
  chart, prices, common ... 48
    trend of world production ... 35
  production, 1887-1925 ... 49
Lepidolite ... 108
Lime ... 73
  production, 1894–1925 ... 74
Limestone ... 107
  dust ... 88
  production, 1894–1925 ... 107
Lithia ... 108
Lorenz Hydraulic Mine ... 43
Los Angeles County ... 136

Macadam ... 88
Madera County ... 137
Magnesite ... 74
  duty on ... 78
  imports of ... 77
  occurrence of ... 75
  producing districts ... 75
  production, 1887–1925 ... 78
  uses of ... 75
  values of ... 77
Magnesium salts ... 124
Manganese ... 49
  imports of, from Brazil ... 49
  total production ... 49–50
Map, outline of California showing oil fields ... 27
Marble ... 79
  production, 1887–1925 ... 79
Marin County ... 137
Mariposa County ... 138
Mariposite ... 88
Mashaw & Swanson, cited ... 20

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Page

Masser, H. L., cited ---- 17
Melhase, John, cited ---- 100
Mendocino County ---- 138
Mercantile Trust Review, cited ---- 45, 68
Merced County ---- 138
Metals ---- 34–61
Mica ---- 108
Mineral industry, review of ---- 11
  graph showing annual value and increase ---- 14
  output by counties ---- 13, 128–153
    by substances ---- 12
  output, comparative value, 1924–1925 ---- 13
  paint ---- 109
  production of, California, totals by years, since 1887 ---- 14
  water ---- 110
    effect of prohibition on ---- 110
    production, 1887–1925 ---- 111
Minerals, total production of, by years ---- 14
  variety of, produced in California ---- 11
Mining Bureau Act ---- 154
Miscellaneous stone ---- 83
  production, 1893–1925 ---- 89
Modoc County ---- 139
Molding sand ---- 86
Molybdenum ---- 50
Mono County ---- 139
Monterey County ---- 139
Montmorillonite ---- 100
Monumental stone ---- 72
Morganite ---- 101

Napa County ---- 140
Natural gas ---- 15, 16
  chart, production and utilization ---- 18
    production casing-head gas ---- 18
  gasoline from ---- 19
  production, 1888–1925 ---- 18, 19
Nevada County ---- 141
Nickel ---- 51
Nitrates ---- 124
Nitrogen, atmospheric, fixation of ---- 124

Oil (*See* Petroleum)
  fields, chart of approximate location of ---- 27
  lands, proved ---- 33
  shale ---- 113
Onyx ---- 79
Orange County ---- 141
Osmiridium ---- 51
Oxychloride cement ---- 78

Pacific Gas & Electric Co., cited ---- 15
Palladium ---- 51
Paving blocks ---- 84
Peat ---- 15
Pebbles for grinding mills ---- 84
P. & H. gasoline steam shovel ---- 84
Petroleum ---- 20–33
  average price by counties, 1916–1925 ---- 22
  capitalization ---- 30
  dividends from ---- 31
  drilling and development ---- 21
  features of, 1925 ---- 21
  financial tables ---- 30–32
  map of California, approximate location of oil fields ---- 27
  operating costs by fields ---- 32
  outlook for 1926 ---- 21
  prices by fields ---- 32
  production, 1875-1925 ---- 24
  production and value by counties ---- 22
  production by fields ---- 25, 28
  production of light and heavy gravities ---- 25
  production statistics, 1925 ---- 22, 25, 28
  proved oil land ---- 33
  statistics of well operations ---- 24
  storage of ---- 26
    and price changes ---- 21
  yield per day of wells ---- 24, 28, 32
Phosphates ---- 111
Pierce gravel gold washing machine ---- 45
Plaster and brick sand ---- 86
Plaster mill ---- 104
Platinum ---- 51
  consumption of, by industries ---- 52
  from blister copper ---- 52
  production of, 1887–1925 ---- 53
  stocks ---- 53
  uses, markets and consumption ---- 52

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PAGE
Plumas County ---- 142
Porcelain ---- 96, 115
Portland Cement Co., Imperial Co. ---- 104
  new cement plant ---- 68
Potash ---- 125
  total production of ---- 125
Pottery clays ---- 94
Proved oil land ---- 33
Publications of State Mining Bureau ---- 157
Pumice ---- 111
Pyrites ---- 112
  total production ---- 112

Quartz ---- 101
  crystals ---- 101
Quicksilver ---- 53
  imports of ---- 54
  production, 1850–1925 ---- 55
  production of, in United States ---- 54
  prices ---- 53
  uses of ---- 54

Radioactivity of hot springs ---- 110
Red earthenware ---- 96
  roofing granules ---- 88
Reed, A. H., cited ---- 98
Rhodonite ---- 101
Riprap ---- 88
Riverside County ---- 142
Roofing granules ---- 88
  sand ---- 86
  slate ---- 82
  tile ---- 96
Rubble ---- 88
Rubies ---- 102
Ruthenium ---- 51
Railroad Comm., cited ---- 17

Sacramento County ---- 143
Salines ---- 120–127
'Salt cake' ---- 127
Salt ---- 126
  production, 1887–1925 ---- 126
San Benito Asbestos Co. ---- 91
San Benito County ---- 143
San Bernardino County ---- 144
San Diego County ---- 144
San Francisco Bulletin, cited ---- 23
San Francisco County ---- 145
San Joaquin County ---- 145
San Luis Obispo County ---- 146
San Mateo County ---- 146
Sand and gravel ---- 85
Sandstone ---- 80
  production, 1887–1925 ---- 80
Sanitary ware ---- 96
Santa Barbara County ---- 146
Santa Clara County ---- 147
Santa Cruz County ---- 147
  Portland Cement Co. ---- 66
Sapphires ---- 102
Scheelite ---- 58
Semi-vitreous tableware ---- 96
Serpentine ---- 81
Sewer pipe ---- 96
Shale oil ---- 113
Shasta County ---- 148
Sierra County ---- 148
Silica ---- 114
  total production ---- 115
Sillimanite ---- 115
Silver ---- 55
  chart, prices, bar silver ---- 56
  production by counties ---- 56
  production, 1880–1925 ---- 57
Siskiyou County ---- 149
Slate ---- 81
  production, 1889-1925 ---- 83
  roofing on residence ---- 82
Soapstone ---- 116
  total production ---- 117
  uses ---- 116
Soda ---- 127
  total production ---- 127
Solano County ---- 149
Sonoma County ---- 149
Specific gravities of oil produced ---- 25
Spelter (*See* Zinc)

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	Page
Spessartite	101
Standard Oil Bulletin, cited	26
Company, cited	25
Stanislaus County	150
State Mineralogist Report, cited	17, 21, 23, 25, 26, 55
list of	157–159
Oil and Gas Supervisor, cited	17, 20, 21, 25, 26
Steatite	116
Stocks of copper in United States	42
platinum in United States	52
Stone, miscellaneous	83–89
production by counties	88
production by years	89
Stoneware	96
Strontium	118
Structural materials	62–89
Stucco dash, granules for	86, 88
Sulphur	118
Sutter County	150
Talc	116
uses	116
Tehama County	151
Terra cotta	96
Tile	96
Tin	57
Topaz	101
Torbanite	113
Tourmaline	38, 101
Trans. Amer. Inst. Min. Eng., cited	38
Travertine	79
Trinity County	151
Tube mill pebbles	84
Tuff, used for building stone	70, 72
Tulare County	151
Tungsten	58
total production	59
Tuolumne County	152
Turquoise	102
United States Bureau of Mines, cited	20, 41, 44, 52, 54, 56, 74, 82, 92, 113
Dept. of Agriculture, cited	110
Geological Survey, cited	24, 42, 47, 55, 78, 102, 110
Tariff Comm., cited	76
Vanadium	60
Ventura County	152
Volcanic ash	111
cinders	86
Water glass	114
Witherite	94
Wolframite	58
Yolo County	153
Yuba County	153
Zinc	60
California Zinc Co.	61
chart, prices slab zinc	60
trend of world production	35
total production	61

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